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A TEXT BOOK

OF

HUMAN ANATOMY,

DESIGNED TO

FACILITATE THE STUDY OF THAT SCIENCE.

BY

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TO

JAMES SMITH, ESQ., OF JORDANHILL, F.R.S.,

President of the Andersonian University,

UNDER WHOSE AUSPICES,

AND

BY WHOSE TALENTS,

PUBLIC SPIRIT, AND INDEFATIGABLE INDUSTRY,

The Andersonian University has attained

MUCH OF ITS FAME AND PROSPERITY,

THIS LITTLE WORK

IS DEDICATED WITH EVERY SENTIMENT OF RESPECT

AND REGARD

BY HIS MOST OBEDIENT SERVANT,

THE AUTHOR.

PREFACE

(DEDICATORY)

TO THE FIRST EDITION.

TO THE STUDENTS OF ANATOMY IN THE ANDERSONIAN UNIVERSITY, GLASGOW.

GENTLEMEN,

THIS Short Anatomical Outline has been drawn up solely for your benefit. It will enable you to follow with more effect the demonstrations and lectures, as it places before you a notification, or short statement, of every important fact, or assemblage of facts, discussed in the anatomical lectures delivered in this place. It will be a guide to you in your studies at home, as it delineates the course you ought to pursue in investigating any anatomical subject; and it will even materially assist you in your practical studies, as it not only indicates a simple arrangement of all the parts entering into the formation of the osseous—muscular—vascular—nervous and splanchnological systems,—but as it likewise refers to the different textures, and their relationships to each other, in the more complicated organs of the body.

That this unpretending little volume may prove useful in promoting the advancement of your anatomical knowledge, is the sincere and anxious wish of

THE AUTHOR.

ANDERSONIAN UNIVERSITY,
GLASGOW, 1*st* *Nov.* 1833.

PREFACE.

THE very flattering manner in which the first edition of this little work was received by the medical students of the Andersonian University; for whose use it was exclusively intended, has induced the author, in undertaking a second edition, to extend somewhat the original plan, so as to render it not only available to medical students generally, but as a book of occasional and easy reference to the more advanced members of the profession. In this edition, the facts of the science are given in a systematic and very condensed form; and in a manner better calculated, the author conceives, to lead the student to a more effective method of studying the subject, than that usually followed up in our prolix and ponderous systems of descriptive anatomy. It has been the author's aim not to exhaust the subject, but to enable the student to exhaust it:—not so much to read the book of nature to the student, as to point out the manner by which the student himself may read that book, and at the same time understand it. In a word, it has been the object of the author to lead the student to investigate anatomical science in a simple, methodical, and practical manner.

ANDERSONIAN UNIVERSITY,
GLASGOW, 1*st Nov.*, 1838.

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INTRODUCTION.

ANATOMY, as the science of organisation, embraces inquiries connected both with vegetable and animal structure.

The organisation of vegetables falls within the scope of the science of botany, and the organisation of animal matter more particularly within the province of anatomy. Even when thus restricted, anatomy, from the numerous and important subjects it embraces, has been branched out into various and somewhat independent subjects of investigation. Hence we have different kinds of anatomy, as human and comparative, general and special, descriptive and surgical, normal and pathological, philosophical and transcendental.

Human anatomy is the science that treats of the structure and organisation of the human body. A knowledge of this department of anatomical science is of pre-eminent importance to the medical practitioner, and can only be attained by a long-continued and careful investigation of the human structure itself, and by a profound study of all the other branches of the science of organisation.

The structure of the human body is usually investigated by dissection: a process which, in the first place, enables the manipulator to obtain a view of every organ and texture of the body; and which, secondly, imparts a facility in the use of the dissecting instrument, that cannot fail to prove of incalculable benefit to the student as a surgical operator.

Dissection may be employed either for the purpose of obtaining a knowledge of the existence, physical qualities, and relative situation of the *larger* parts and masses in the body, as the bones, muscles, blood vessels, nerves, viscera, &c.—a species of knowledge which may be turned to many useful purposes in the practice of medicine and surgery; or it may be used for disclosing the more *minute* and *intimate* structure of any organ: a kind of knowledge which is calculated to lead to important conclusions regarding the functions of organs, both in their natural and diseased condition.

For accomplishing the first of these purposes or performing the coarser kinds of dissection, the common dissecting instruments sold in the shops will be found necessary and sufficient; but in prosecuting the minuter anatomical investigations, the *subject* requires first to be injected with some fluid material, as melted tallow or wax, or, if a very minute injection is required, with turpentine, size, or quicksilver; then macerated in water, or hardened, it may be, with alcohol or other means, and afterwards dissected, sometimes even under water, or traced under the guidance and magnifying influences of the microscope with some delicate instrument as the point of a cataract needle.

The *elementary constituents* of the human body have been found to consist of oxygen, hydrogen, carbon, nitrogen, sulphur, phosphorus, chlorine, fluorine, potassium, sodium, calcium, magnesium, manganese, silicium, iron. The first four are found in all animal bodies, and constitute uniformly the principal ingredients. The others are found only in isolated textures, and some of them in extremely minute quantities. These elementary constituents of animal bodies combine under the operations of the living system, and form every variety of animal organic texture. By the combination of these elementary constituents in certain definite proportions, as three and three, four and four, &c., the *proximate principles* of animal bodies are formed, and of which the following are the most important:—albumen, gelatin, fibrin, mucus, olein, casein, uric acid, urea, and osmasome.

The various parts of the human body exist either in a *fluid* or *solid* form: the solids being the only parts that are strictly organised, imparting form and character to the living body; and the fluids, besides serving other purposes, affording the requisite pliancy to the solids, and thus adapting them for the better performance of their functions. The fluids of the human system predominate over the solids, in the proportion of nine to one; and although fluids and solids differ so much in their physical properties, yet they are mutually dependent—analogous in their chemical composition, and convertible into each other.

The *Fluids* of the animal system have been variously arranged by different physiologists. The older physiologists seem to have been guided in their arrangement by the physical qualities of the fluids: in more modern times, physiological properties chiefly attracted attention, and at the present day, the best arrangements are founded upon chemical qualities. Probably the most scientific that has yet been published is the following of Dr Bostock:—1st, the aqueous; 2d, the albuminous; 3d, the mucous; 4th, the gelatinous; 5th, the fibrinous; 6th, the oleaginous; 7th, the resinous; 8th, the saline.

The animal *Solid* exists in one of two forms. It is either concrete like gelatine or glue, or fibrous like muscle or brain. The concrete is an *inorganic* product diffused or secreted from the living textures; while the fibrous is the part truly organised, and constituting an essential ingredient of every texture. These fibres present in different textures a twofold appearance. In some they retain the form of threads or fibres, and in others so disposed as to form laminæ or plates. Hence every organised texture is either fibrous or laminous.

All the organic parts of the body may be comprehended, still more particularly, under the following designations:—1st, globules; 2d, filaments; 3d, fibres; 4th, tissues; 5th, organs; 6th, apparatus; 7th, systems. We may view the animal globule as the real *elementary solid*. By the union of a number of globules in a lineal direction, a filament is formed; the apposition of a number of filaments constitutes a fibre; a peculiar arrangement of fibres constitutes a tissue; an organ is a more compound body, consisting of a determinate arrangement of different tissues; an apparatus is an assemblage of organs, all of which assist in the production of one grand result, as the apparatus of digestion; and a system is an assemblage of organs, all of which have a similarity of structure, as the osseous system, the muscular, the vascular, the nervous, &c. By the union and conversion of globules into filaments, of filaments into fibres, of fibres into tissues, of tissues into organs, and of organs into apparatus and systems, the complicated animal machine or body is formed.

Guided by an arrangement founded upon physiological principles, the organs of the human body, though forming a grand whole, may be viewed still farther as consisting of three classes. 1st—Those of relative life, or those which connect us to external nature, and enable us to discover, appreciate, and enjoy, the relationship in which we are placed. 2d—Those of vegetative or nutritive life, or those under whose influence the whole system grows, is repaired, and continuously supported; and 3d—Those of reproductive life, or those that conduce to the preservation of the species, or by which the new being is formed, elaborated, and rendered susceptible of an independent existence.

The first class includes the passive and active organs of locomotion, as the bones and muscles; and the sensitive system generally, including the brain and spinal cord—the nerves, and the external organs of sensation.

The second class comprehends the organs of digestion, absorption, circulation of the blood, respiration, and secretion.

And the third class the organs peculiar to the two sexes, viz. those of copulation, conception, gestation, and parturition.

Such an arrangement, although not perfect, is simple and useful. It shows the connection that subsists between anatomy and the kindred science of physiology; leads the student to investigate the *general* operations of the animal machine; and to observe the functional bearings which the *individual* organs hold to each other.

In describing the structure of the human body, we are called upon to refer frequently to *Comparative* anatomy. In the human being, the organs exist generally in a high, and not unfrequently in the very highest state of development or complexity. Difficulty is consequently experienced in determining the accessory from the essential parts of any organ. In man, besides, there exists a reciprocal influence among those complex organs which produces overwhelming difficulties in determining the precise uses of each organ: but in the lower animals we obtain a view of all the organs in varied degrees of complexity, and in every variety of combination. In some animals we find an organ or organs in the greatest complexity: in others, the same organ is stripped of all its accessories; and in others, the whole organ is withdrawn, and the effects of these modifications and deprivations exposed to our view. No human physiology can be sound, which is at variance with general physiology; and general physiology cannot be perfected, except by observing and comparing the functions of all animals to which any peculiar modification of structure has been imparted. In this way only can we ever hope to keep the facts of special physiology within proper bounds, and ascend to the general laws that regulate the whole of the animal creation.

As we must frequently refer in our lectures to Cuvier's arrangement of the animal kingdom, the following tabular view of its great outlines will be found useful to the student:—

Cuvier conceives that there are four general or principal forms, into which all animals may be arranged; these he denominates—1st, vertebrata; 2d, mollusca; 3d, articulata; 4th, radiata or zoophyta.

1st Form.—VERTEBRATA.

Classes.	*Examples.*
1. Mammalia.	Man. Whale.
2. Aves.	Eagle. Duck.
3. Reptilia.	Tortoise. Frog. Serpent.
4. Pisces.	Salmon. Eel.

2d Form.—Mollusca.

Classes.	*Examples.*
1. Cephalopoda.	Nautilus. Sepia.
2. Pteropoda.	Clio.
3. Gasteropoda.	Snail. Limpet.
4. Acephala.	Oyster.
5. Brachiopoda.	Lingula.
6. Cirrhopoda.	Barnacle.

3d Form.—Articulata.

Classes.	*Examples.*
1. Annelida.	Leech. Earth-worm.
2. Crustacea.	Lobster. Crab.
3. Arachnida.	Spider.
4. Insecta.	Bee. Beetle.

4th Form.—Radiata or Zoophyta.

Classes.	*Examples.*
1. Echinodermata.	Star-fish.
2. Intestinalia.	Tape-worm.
3. Acalepha.	Actinia.
4. Polypi	Sponge. Coral.
5. Infusoria.	Monas.

Various modifications of this arrangement have been made; the latest and most important is that proposed by Dr Grant, who retains the primary divisions of Cuvier, but changes the number, the position, and many of the names of the classes. The following tabular view will impart some idea of his arrangement:—

1st Division.—Spino-Cerebrata or Vertebrata.

1. Mammalia.
2. Aves.
3. Reptilia.
4. Amphibia, (*different from Cuvier.*)
5. Pisces.

2d Division.—Cyclo-gangliata or Mollusca.

6. Cephalopoda.
7. Pteropoda.
8. Gasteropoda.
9. Conchifera, } (*different from Cuvier.*)
10. Tunicata, }

3d Division.—Diploneura or Articulata.

11. Crustacea.
12. Arachnida.
13. Insecta.
14. Myriopoda, (*different from Cuvier.*)
15. Annelida.
16. Cirrhopoda, (*Cuvier places this among Mollusca.*)
17. Rotifera, } (*different from Cuvier.*)
18. Entozoa, }

4th Division.—CYCLO-NEURA OR RADIATA.
19. Echinoderma.
20. Acalepha.
21. Polypiphera,
22. Poriphera, (*different from Cuvier.*)
23. Polygastrica,

The natural history of man is a theme of far higher interest than that of any other animal. By his superior mental endowment, he is elevated to an immeasurable distance above all other animals; and although all that is animal in them belongs also to us, still our superadded powers place us on a mighty vantage ground, and prompt us to seek purer pleasures and a higher destiny. Some fanciful philosophers have imagined that man has descended from the monkey tribes: but the opinion is not only revolting to common sense, but is utterly at variance with the established doctrines of zoology. Nature is uniform in her operations; and as we now find a race of beings we call man, and another race of beings we call monkeys, with different zoological characters, we may safely conclude they have been always distinct.

Various facts and observations lead to the conclusion that man constitutes not only a *distinct* but a *single* species in the animal creation. There are however certain hereditary conformations which give rise to peculiar distinctions among men, and constitute *varieties*. Of these, Cuvier has enumerated three—the Fair, or Caucasian; the Yellow, or Mongolian; and the Black, or Ethiopian; to which other two, viz., the Copper-coloured, or American, and the Malay, or Tawny, are now usually added by naturalists.

The Caucasian is chiefly distinguished by the beautiful form of the head, which approaches to the oval. It is also remarkable for variations in the shade of the complexion and colour of the hair. This division includes almost all the inhabitants of Europe; those of Asia on this side of the Oby, the Caspian, mount Imaus, and the Ganges; also the natives of the North of Africa, of Greenland, and the Esquimaux.

The Mongolian variety is recognised by prominent cheek bones, flat visage, narrow and oblique eyes, hair straight and black, and olive complexion. This variety is confined to Asia.

The Ethiopian, or negro race, may be distinguished by their black complexion, woolly or frizzly hair, compressed cranium, flattish nose, and thick lips. This race inhabits Africa, with the exception of the northern part of that continent.

The Copper-coloured, or American race, is not only distinguished by a complexion resembling burnished copper, but also by a short forehead, deep eyes, broad face, prominent and rounded cheeks, noses not ill-defined, large mouth, and thick lips. This variety includes the whole inhabitants of America, except the Greenlanders and Esquimaux.

The Malay, or Tawny race is characterised by the brown-black colour of the skin,—hair black, and more or less curled,—head rather narrow, bones of the face rather prominent; bottle-nose, and large mouth. This race inhabits the peninsula of Malacca, various parts of Asia, New Holland, and parts in that neighbourhood; South Sea Islands, &c.

The human stature varies from about four feet and a half to six feet. Individuals of six feet and some inches are not uncommon. In various parts of the world men have occasionally reached the height of seven, eight, or even nine feet, but the instances are rare, and appertain only to isolated cases—not to tribes or nations.

We also find, in various parts of the world, individual instances of great diminutiveness of stature—some individuals attaining no greater height than twenty-one inches.

Among the varieties of men, peculiarities of form exist, not only in the *head*, but also in the *trunk* and *extremities*, which well deserve the closest investigation of the medical philosopher; but we must confine ourselves to subjects that fall more directly within the province of anatomy.

The most cursory inspection of the human body leads to the conclusion, that it is of a very complicated structure. We see a variety of parts, such as bones, muscles, vessels, nerves, and viscera, that present physical characters so unlike, that we are led at once to consider them as inherently and essentially different. When we take a closer view, we find that each and all of those parts which appear at first sight simple, as bone, muscle, bloodvessel, nerve, are in reality greatly complicated; and we look in vain for a simple structure. Nature seems to delight in combinations, and the philosopher must analyse her products before they appear in an insulated state.

The unravelling of the elementary textures or *tissues* of the human body has long been a favourite pursuit among anatomists. These textures may be viewed as the *alphabet* of anatomy, the letters of which are few, but from which, by their numerous combinations, a language of great extent may be formed: or like the few elements which chemistry has disclosed, forming, by their combinations, the complicated fabric of this our world.

The first and best systematic work upon the tissues, was that of Bichat.* Vesalius, Malpighi, Ruysch, Haller, John Hunter, Bonn, and Pinel, cleared the way by many important discoveries, and by the very philosophical manner and spirit in which their inquiries were conducted; but Bichat had the merit, not only of adding to the discoveries of his predecessors, but of gathering the knowledge that had been previously collected, and with a masterly hand moulding it into a system, which will stand as an eternal monument of his genius. According to Bichat, the elementary tissues are twenty-one in number; some of which are general or universally diffused, and others of a more particular kind are found only in certain parts of the body. The first, or generally diffused tissues, are the cellular; the nervous, which consists of two kinds, the animal and the organic; the arterial, the venous, the exhalent, and the absorbent:—and the second, or the particular tissues, are the osseous, the medullary, the cartilaginous, the fibrous, the fibro-cartilaginous; the muscular, which consists of two divisions, the animal and the organic; the mucous, the serous, the synovial, the glandular, the dermoid, the epidermoid, and the pilous.

---

* Anatomie Generale, par Xav. Bichat, 1801.

In the following table a somewhat more extended outline of this classification will be found:—

ARRANGEMENT OF THE ELEMENTARY TEXTURES OF THE HUMAN BODY, ACCORDING TO BICHAT.

1st Division.

General, Generating, or Universally Diffused Tissues.

1. Cellular. Subdivided into	Subcutaneous, connecting the skin to the subjacent parts. Subserous, connecting the serous or transparent membranes to the contiguous parts. Submucous, connecting the mucous membranes to the subjacent parts. Arterial, surrounding and enclosing arteries. Venous, - - - - - veins. Excretory, - - - - excretory ducts. Enveloping, - - - - organs. Penetrating, entering into the substance of organs.
2. and 3. Nervous.	*a* Animal Life. *b* Organic Life.
4. Arterial.	
5. Venous.	
6. Exhalant.	
7. Absorbent.	Absorbent vessels. Absorbent glands.

2d Division.

Particular Tissues or those confined to certain parts of the Body.

8. Osseous.	Bones proper, long, flat, and short. Teeth.
9. Medullary.	Marrow of short and flat bones, or the ends of long bones. Marrow of the shafts, or bodies of long bones.

- 10. Cartilaginous.
  - Articular ends of movable bones.
  - Articular surfaces of immovable bones.
  - Ribs, Larynx, Nasal Partition, &c.
- 11. Fibrous.
  - Membranous or Expanded.
    - Proper Fibrous Membrane.
      - Periosteum.
      - Dura Mater.
      - Sclerotic.
      - Albuginea.
      - Membrane of kidneys, spleen, &c.
    - Fibrous Capsules.
      - Scapulo-humeral articulation.
      - Ileo-femoral articulation.
    - Fibrous Sheaths.
      - Partial.
        - Palms of hand and foot.
        - Flexor tendons.
      - General. Annular ligaments.
    - Aponeuroses.
      - Enveloping.
      - Inserted.
        - α By broad surface.
        - β Arched
        - γ By isolated fibres.
  - Fasciculated or Collected
    - Tendons.
      - Simple.
      - Compound.
    - Ligaments.
      - Regularly fasciculated.
      - Irregularly fasciculated.
- 12. Fibro-cartilaginous.
  - Membranous, Fibro-cartilages of the
    - Ears,
    - Nose,
    - Trachea,
    - Eyelids.
  - Articular.
    - Interarticular, those of the knee-joint, lower jaw.
    - Intervertebral fibrocartilages.
- 13 and 14. Muscular.
  - *a* Animal life, all the voluntary muscles.
  - *b* Organic life, *e. g.* heart, stomach, and intestines.
- 15. Mucous, comprehending the gastro-pulmonary mucous surface, and genito-urinary mucous surface.
- 16. Serous, comprehending the arachnoid membrane, pleura, pericardium, peritonæum, and vaginal coat of testicle.
- 17. Synovial.
- 18. Glandular, comprehending the secreting glands only.
- 19. Dermoid or Cutaneous.
- 20. Epidermoid or Cuticular.
- 21. Pilous or Hairy.

Numerous attempts have been made to form new and original arrangements of the primary tissues, but without success; for every such "*new*" classification has been a transcript of Bichat's, modified, no doubt, to impart some air of originality; but, like the daw in the fable, unable to conceal its borrowed grandeur. Among these classifications, that of Dupuytren and Richerand, of Meckel and of Meyer, are the most noted; but it may be justly questioned, if they are superior to that of Bichat. Dupuytren and Richerand have indeed made some little improvement, by the introduction of the erectile texture, omitted by Bichat; and Meyer has added also the lamellar texture, an improvement of a less important kind.

Of the tissues of the human body, *three* may be viewed as primary or fundamental, existing in all animals, and essentially different in their physical, chemical, and physiological properties. These tissues are the cellular, the nervous, and the muscular. The first forms a nidus and bond of union for all the textures of the body; the second, in all animals, imparts sensibility and volition; and the third the capability of moving.

All the other textures, by whatever names they are known, are secondary or derivative. They are modifications merely of the cellular, resolvable into this texture by maceration, and changed in many instances from the primary type of this texture by various degrees of condensation only.

Taking the primary and secondary forms of this texture into consideration, we must view the cellular then as the most abundant of all the textures in the system, and as that which naturally precedes the description of the individual organs and parts of the body.

Cellular or Filamentous Tissue.

This texture has received various names as—the corpus cribrosum of Hippocrates; the reticular membrane of William Hunter; tela cellulosa; tissu cellulaire; tissu muqueux of Bordeu; cellular membrane and cellular substance of many anatomists.

Haller and Charles Augustus de Bergen were among the earliest supporters of the opinion that this tissue was diffused over the whole body, but the earliest examinations of the tissue was by Bordeu and William Hunter.

This tissue consists of delicate filaments or thready lines, which cross each other in every direction, and which, when artificially separated, present the appearance of a confused and irregular network.

In following up this subject, the student should advert—1st, To the structure of these filaments. 2d, To the manner in which they cross each other. 3d, To the form and size of the interstices commonly called cells. 4th, To the secretions that take place in the cavities: and 5th, To the modifications in the structure of the tissue which occur from *situation*, *age*, and other circumstances.

PART I.

THE OSSEOUS SYSTEM,

Including the Bones and Joints, with an Enumeration of the Eminences, Depressions, and Muscular Attachments of each Bone, and the Ligaments of each Joint.

The osseous system constitutes a solid framework for the body, which serves at once for the attachment of the organs of motion, and the protection of the more delicate vital organs. From the manner in which the bones are joined together, and the relationship which they bear to the muscles or moving powers, they form the *passive* organs of locomotion, and the nature of the osseous texture admirably adapts them for such purposes.

When all the bones of the body are insulated from the softer textures, and maintained in their natural relative positions to each other, they form the skeleton. Two kinds of skeletons are usually exhibited in anatomical class-rooms. The *natural* and the *artificial.* In the first the bones are held together by their natural ligaments; and in the second, every soft part is removed, and the bones connected by some mechanical contrivance, or by some *artificial* means.

The skeleton demands a most particular investigation by the student. Without a knowledge of the bones, he cannot follow out or comprehend a description of the muscles; and without a knowledge of the muscles, he must remain ignorant of the situation, course, and distribution of the bloodvessels and nerves.

The bones of the human body have been arranged and classified in various ways by anatomists. Some make a three-fold division of the skeleton, as they do of the body generally: hence they speak of the bones of the *head*, of the *trunk*, and of the *extremities* or limbs. Others, guided by the facts of comparative anatomy, make a division into the primary and secondary bones: the primary comprehending the bones of the spine and head; and the secondary all the other bones of the system. Others, influenced by physiological considerations, arrange the bones into three or four classes, as the long, the flat, and the short; to which some add the mixed, or intermediate betwixt the long and the flat bones.

The following enumeration of the bones of the skeleton, exhibits a classification chiefly according to the first of these methods:—

The SKELETON is composed of,
1st, The Head—2d, The Trunk—3d, The Extremities.

I.—THE HEAD,
comprehends
1st, The Cranium—2d, The Face.

The Cranium is formed by the os frontis, 2 ossa parietalia, the os occipitis, 2 ossa temporum, the os sphenoides, and the os ethmoides.

The Face is formed by 2 ossa nasi, 2 ossa maxillaria superiora, 2 ossa ungues or lachrymalia, 2 ossa malarum, 2 ossa palatina, 2 ossa turbinata inferiora, the vomer, and the os maxillare inferius.

II.—THE TRUNK.
is formed of
Primary and Secondary Bones.

The Primary Bones are those of the *spine*, which consist of 7 *cervical* vertebræ, 12 *dorsal* vertebræ, 5 *lumbar* vertebræ, 5 *sacral* vertebræ, when united called the sacrum, and 4 *coccygeal* vertebræ, or united called the coccyx.

The Secondary Bones comprehend the ribs, 12 on each side (7 sternal and 5 asternal), and the sternum.

III.—THE EXTREMITIES OR LIMBS,
are of two kinds,
1st, The Superior—2d, The Inferior.

The Superior or Thoracic Limbs consist each of 4 subdivisions—a shoulder, an upper arm, a fore arm, and a hand.

The *shoulder* includes the clavicle and scapula.

The *upper arm* consists of the humerus.

The *fore arm*, of the radius and ulna.

The *hand* consists of three parts—the *carpus, metacarpus*, and *phalanges of the fingers.*

The *carpus* is composed of two rows of bones—the upper row, of the scaphoides, lunare, cuneiforme, pisiforme—the lower row, of the trapezium, trapezoides, magnum, unciforme.

The *metacarpus*, of 5 bones—1st, 2d, 3d, 4th, 5th.

The *phalanges*, of 14 bones—3 in each of the smaller fingers, and 2 in the thumb.

The Inferior or Pelvic Limbs are made up of 4 subdivisions—a haunch, a thigh, a leg, and a foot;

The *haunch* consists of the os innominatum—divisible in the young subject into the ilium, the ischium, and the pubes.

The *thigh*—of the femur.

The *leg*—of the tibia, fibula, and patella.

The *foot* is formed of 3 subdivisions—a *tarsus*, a *metatarsus*, and *phalanges* of the *toes.*

The *tarsus* consists of the astragalus, naviculare, cuneiforme internum, cuneiforme medium, cuneiforme externum, calcis, cuboides.

The *metatarsus* of 5 bones—1st, 2d, 3d, 4th, 5th.

The *phalanges* of the *toes*, of 14 bones—3 for each of the small toes, and 2 for the great toe.

Besides the above, the following are generally enumerated among the bones of the skeleton, viz., the teeth, 16 in each jaw; 4 bones in each ear—the malleus, incus, orbiculare, stapes; the os hyoides, or bone of the tongue, and the sesamoid bones, the number of which varies both in the upper and lower extremity.

Each of the three grand divisions of the skeleton assists in the formation of a *cavity* of great importance in the economy; the first is formed by the *cranium* exclusively, and lodges the brain; the second by the *thorax*, which is formed of the twelve ribs on each side, the sternum before, and the twelve dorsal vertebræ behind; and the third by the *pelvis*, which is formed by the two ossa innominata, the sacrum and coccyx.

Many anatomists have amused themselves by hunting out analogies of form between the different parts of the skeleton. Meckel thinks he can discover an analogy of this kind between the opposite extremities of the trunk; the head at the one extremity, and pelvis at the other, forming the analogous expansions. But, without prosecuting the subject in too curious a manner, we cannot but be struck with the exact resemblance that exists between the two *lateral* halves of the skeleton, and the striking analogy that obtains, not only in the great subdivisions, but also among the individual bones of the *upper* and *lower* limbs.

The colour, solidity, hardness, and cohesion of the osseous texture, are physical qualities, so obvious and well known, that they require no particular description: yet it must be remembered that these qualities vary considerably with age and other circumstances. The *colour* is always white, or whitish with a bluish tint in the young subject, and often a yellowish appearance in the old; the former depending upon the larger proportion of cartilage which the bone then contains, and the latter upon the colour and greater quantity of the medullary secretion.

The solidity and hardness of bone invariably increase with age, and both from the proportionably greater quantity of calcareous matter which is deposited; while from the same cause the cohesive property of bone necessarily diminishes.

On the *external surface* of bones we find both eminences and depressions. The eminences or processes are of two kinds—articular and non-articular; and the depressions admit of a similar classification.

The articular eminences, as the name denotes, enter into the formation of articulations, and the *non-articular* eminences afford advantageous attachment to various other textures.

The articular depressions, like the corresponding eminences, enter into the formation of joints; and the non-articular depressions lodge in various ways, and afford points of attachment to many of the softer textures of the body.

The following table of these eminences and depressions, abridged from a very useful compendium of practical anatomy,* should be carefully perused by the student:—

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* The Edinburgh Dissector.

- PROCESSES
  - Serve for articulations.
    - Those of the movable articulations: are
      - *Heads*, which are nearly hemispherical.
      - *Condyles*, which are broader in one direction than in the others.
    - Those of the immovable articulations: are
      - *Serræ*, or *Dentations*, as in the bones of the cranium.
      - *Roots*, as in the teeth.
      - *Ridges*, as seen in those articulations, called *schindyleses*.
  - Destined for the insertion of fibrous organs, whose points of attachment they multiply, are called,
    - According to their general form,
      - *Lines*, eminences, long but not prominent.
      - *Crests*, eminences resembling lines, but broader and more prominent.
      - *Prominences*, when they are rounded, broad and smooth.
      - *Tuberosities*, when rounded and rough.
    - After the bodies to which they have been compared,
      - *Spinous processes*, that have the form of a spine.
      - *Styloid*, like a style.
      - *Coracoid*, like a crow's beak.
      - *Odontoid*, like a tooth.
      - *Mastoid*, like a nipple.
    - According to their uses.
      - *Trochanters*, or those which are subservient to the art of turning.
      - *Orbitar*, belonging to the orbit, &c.
    - According to their direction and situation.
      - *Ascending processes.*
      - *Vertical.*
      - *Transverse.*
      - *Superior*, &c.
- The external *Cavities* of bones, when
  - *Articular*, are called
    - *Cotyloid*, when they are hemispherical.
    - *Glenoid*, when broad and shallow.
    - *Trochleæ*, when they are grooved like pulleys.
    - *Facet*, when nearly plain.
    - *Alveoli*, when they are conical.
  - *Non-articular*, are called
    - Of *reception*, these are,
      - *Fossæ*, when the entrance is wider than the bottom.
      - *Sinuses*, when the entrance is narrower.
    - Of *insertion*, these are,
      - *Impressions*, when they are wide, irregular, and shallow.
      - *Fissures*, when extended in length.
      - *Grooves for the passage of tendons.*
    - Of *impression*, which are called,
      - *Grooves, gutters*, or *channels*, when they correspond to arteries or veins.
    - Of *transmission*, named,
      - *Notches*, when superficial, and formed in the edges of bones.
      - *Foramina* or *holes*, when they pass through and through a thin bone.
      - *Canals* or *aqueducts*, when their passage is of great extent.
      - *Clefts* or *scissures*, if they are longitudinal and very narrow.
    - Of *nutrition*; they transmit vessels for
      - The spongy tissue of the short bones, and of the extremities of the long bones.
      - The compact tissue.

By making a section of a bone, we are enabled to obtain a view of its *internal* structure. We thus apparently expose two kinds of osseous structure—the *compact* and the *reticulated* or cancellated: the former confined chiefly to the walls of the shafts of long bones, and the exterior of all the bones of the body; and the latter occupying the extremities of the long bones and the interior of the short and flat. These two kinds of the osseous texture are, however, essentially the same. When viewed by the microscope, the most compact osseous texture is found to consist of cells, and the cells of the compact differ from those of the reticulated in size only.

Canals for the transmission of blood-vessels are also exposed by a section of a bone. These canals are in some instances large, for the transmission of the principal nutrient artery and its ramifications; and in other instances much smaller, for the transit of vessels through almost every point of its surface.

In unravelling the osseous texture, we have recourse also to chemical means. We macerate it in a weakened mineral or vegetable acid, or we subject it to the action of fire, and observe the results. When a bone is treated according to the former plan, it becomes soft and pliant; we can bend it like a piece of leather; and although it retains its form and dimensions, it loses remarkably in weight. When subjected for some time to the action of fire, although it neither loses form nor dimensions, yet it loses sensibly in weight, and its cohesion becomes so weak, that a slight pressure reduces it to a powder. The acids in the first of these processes abstract an earthy matter, and leave the animal matter in an insulated state, and the fire destroys the animal matter and leaves behind, the earthy.

By the action of a weakened acid, bone may be resolved into cellular membrane. The middle part of the shaft of long bones, as the femur or humerus, is by this process first reduced to laminæ, and these laminæ, by farther maceration, can be made to assume the cellular character. We may consider bone then to be of a cellular structure.

Various opinions have been entertained regarding the *intimate* structure of the osseous texture. That it is areolated is generally admitted, and the calcareous matter, in extremely minute quantities, is supposed to be deposited in a manner somewhat similar to that of water contained in the cells of a sponge. Others have viewed the osseous fibre as a uniform combination of gelatine and calcareous matter. Mascagni regarded the osseous texture as formed by absorbent vessels filled with the phosphate of lime, and the more modern microscopic observers lay much stress upon the osseous corpuscles and tubules, which are seen scattered through the more pellucid cartilaginous substance. Notwithstanding all that has been said or done, it must be remarked, that we are still totally ignorant of the manner in which the calcareous matters are incorporated with the other tissues of the bone, and conjectures on this subject would be endless and unprofitable.

From the chemical process above referred to, bone is found to consist of mineral and animal matter. The mineral matter was first suspected to exist by Herrisant, and afterwards proved to be chiefly phosphate of lime by Gahn.

The animal matters of bone consist of the following textures:—1st, cellular texture; 2d, arteries; 3d, veins; 4th, lymphatics; 5th, nerves; 6th, the periosteum or investing membrane; 7th, the medullary membrane—that which lines the cells in the interior of the bone, and which secretes the marrow or oleaginous fluid found in these cells.

According to Berzelius, 100 parts of dry bones consist of animal matters, 33.3; phosphate of lime, 51.04; carbonate of lime, 11.30; fluate of lime, 2; phosphate of magnesia, 1.16; and soda, muriate of soda and water, 1.2.

Mr Hatchett also found a small quantity of sulphate of lime; and Fourcroy and Vaquelin discovered traces of alumina, silica, and the oxides of iron and manganese.

The osseous system is not fully formed till about twenty-five years after birth. At the period of birth, the skeleton is partly cartilaginous, and with age the cartilage gradually diminishes, and osseous matter in a corresponding degree takes its place till the osseous system has attained its measure of development.

During the process of development, this system passes through three states or conditions, viz., the mucous or gelatinous, the cartilaginous, and the osseous. Every bone is formed of a centre or centres of ossification, and these *puncta ossificationis* are uniformly developed in the interior of cartilage.

The *flat* bones are formed from central points, from which radiations shoot towards the circumference, or more properly, the bone increases by additions made to its circumference.

The *short* bones commence in the centre of the cartilage, and extend in every direction till they are completed.

The *long* bones are formed somewhat differently. Each is formed from three centres, one of which corresponds with the *shaft* of the bone, and the *ends* of the bone, or epiphyses, are formed each by a distinct centre, as in the short bones. The bone is completed by the consolidation of the three pieces into one.

Without referring to the various opinions that have been entertained regarding the agents by which the ossific process is effected, it may be generally stated, that it is not attributable to any mechanical cause converting gelatinous matter into cartilage, and cartilage into bone: that it is not effected by the conversion of any of the peculiar tissues of bone, as the bloodvessels, into osseous matter: that bone is not formed exclusively by or from the periosteum, but that ossification results from a specific action of bloodvessels, the nature of which action is unknown.

SECTION FIRST—THE BONES.

I.—*First division of the Skeleton.*

HEAD OR SKULL.

In studying this part of the skeleton our attention should first be directed to its great outlines or markings; and secondly, to the individual bones that enter into its formation. In reference to the first, the following particulars require to be noted.

I. The *general spheroidal form*—which varies more or less in individuals, and more particularly in nations.

II. The *external surface* of the skull which is susceptible of a farther subdivision into 6 *aspects*—a superior or coronal—an inferior—an anterior or facial—two lateral or temporal—and a posterior or occipital—and on which we also find the following *fossæ* and *sutures.* On the *facial aspect* the *fossæ* are the orbital, nasal canine, myrtiform and mental: on the *inferior aspect*—the palatine and guttural: and on the *lateral aspect*—the temporal zygomatic, and spheno-maxillary. The *sutures* or seams formed by the union of the different bones of the head, may be arranged into 3 sets. 1st. Those formed by the junction of *cranial* bones. 2d. Those formed by the junction of both facial and cranial bones. And 3dly. These formed by *facial* bones. The *cranial* sutures are the coronal, sagittal lambdoidal, additamenta suturæ lambdoidalis, temporal or squamous, additamenta suturæ squamosæ, sphenoidaland ethmoidal. The *cranio-facial* sutures are the transverse and zygomatic, and the most important of the *facial* are the nasal, mystachial and palatine.

III. The *internal surface* of the skull, consists of a superior part or *vault:* and 2d, of an inferior part or *floor*, indented by nine *fossæ*, three of which, the ethmoidal, pituitary, and basilary, occupy the mesial line of the floor, and *three* the anterior lateral, middle lateral, and posterior lateral, bound these on *each* side. Besides these fossæ numerous foramina and fissures are also to be found.

IV. The *structure of the cranial walls* which is seen by removing the skull-cap, when we obtain also a view of the cranial *cavity* or lodging place of the brain. In the adult cranium, these walls consist of, 1st. An external plate of bone, 2d. A cancellated structure, the diploe or meditullium and, 3d. Of an internal plate, the *tabula vitrea*, which is more condensed and brittle than the external table.

V. *The form of the skull at the period of birth*, which differs remarkably from that of the adult, and more particularly in the following circumstances. 1st. In the greater relative size of the head to the whole body. 2d. In the greater size of the cranium relatively to the face. 3d. In the greater number of osseous pieces that form the cranium. 4th. In the looseness of the bones of the cranium. 5th. In the thinness of these bones, and, 6th. In the existence of membraneous spaces, called fontanelles or bregmata, in various parts of the head. Six *fontanelles* are found at this period. The two largest or the great fontanelles in the mesial line: and the smallest fontanelles at the lateral parts of the cranium. Of the former the *anterior superior* or *frontal*, is the largest and forms the *opening* of the head, and the *posterior superior* or *occipital*, though much smaller is generally well defined. The *inferior* fontanelles, are not unfrequently obliterated at the period of birth. When existing, the *anterior inferior* or temporal is generally smaller, than the posterior inferior, or as it may be called from its situation the mastoidean fontanelle.

It is absurd to talk of the *uses* of the fontanelles; they result simply from the undeveloped state of the cranial bones: and the opinions of the ancients, from which the term *fontanelle* has been derived, are unworthy of the smallest consideration.

BONES OF THE HEAD.

In this division of the skeleton some of the osseous pieces are arranged so as to form a protecting encasement for the brain, and others by their peculiar allocation, lodge and defend the principal organs of sensation. The first are called *cranial* bones, because they form the cranium, and the second *facial* bones, because they enter into the formation of the face.

CRANIAL BONES.

Four of these bones, viz., the frontal, the occipital, the sphenoidal, and ethmoidal, situated in the mesial line of the cranium are single: the parietal and temporal bones are each double, and constitute more of the sides of the cranial walls than the other.

Another simple arrangement of these bones may be formed by viewing the cranium, as consisting of three osseous rings or cinctures—an anterior, a middle and a posterior. The anterior or fronto-ethmoidal is formed of two bones, the frontal and ethmoidal; the middle or parieto-temporo-sphenoidal of five bones, the two parietal, the two temporal and the sphenoid, and the posterior or occipital circle by the occipital bone. We shall follow this arrangement.

Individual bones of the cranium.

A full description of these or of any bone in the body, must embrace the following particulars. 1st. The names and synonymes or various names by which the bone is known. 2d. Its situation. 3d. Its form. 4th. Its surfaces. 5th. Its margins. 6. Its processes or eminences. 7th. Its depressions by whatever name they are known, as foramina, notches, fossæ, sinuses, &c. 8th. Its structure. 9th. Its mode of development. 10th. Its junctions or articulations with other bones, and, 11th. Its fibrous attachments, as muscular, ligamentous, &c.

In our anatomical lectures all these particulars require to be investigated with respect to each bone; but we shall only note here the more important of the above points, indicating particularly, however, the *processes*, *depressions*, and *muscular attachments* of each bone.

ANTERIOR CRANIAL CINCTURE.

Formed by the os frontis and os ethmoides.

OS FRONTIS.

Situation.—Upper part of the face and anterior of the cranium.

Form, symmetrical, semicircular and somewhat resembling the cockleshell, to which it has frequently been compared. It presents two surfaces, one of which is external, and the other internal: two margins a superior and an inferior: and may still farther be divided into a frontal, and two orbitary portions.

Processes. Upon the *external surface of the bone*, the following appear;—frontal line, frontal protuberances, nasal eminences, nasal spine, superciliary arches, internal angular, external angular, temporal: and upon the *internal surface* the mammillary eminences and internal spine.

Depressions. Of four kinds *foramina*, *notches*, *fossæ*, *sinuses*. *Foramina*—superior orbitary, anterior internal orbitary (part of), posterior internal orbitary (part of), cœcum. *Notches*—nasal, ethmoidal. *Fossæ*—lachrymal, trochlear, temporal, longitudinal. *Sinuses*—frontal.

Muscles attached. Occipito-frontales, corrugatores supercili-orum orbiculares palpebrarum, and the temporales.

In a *practical* point of view the following parts of the bone require the particular examination of the student. 1st. The orbitary plates, their thinness, their position in the orbit, and relation to the brain. 2d. The sinuses, their form, size, communications with the nostrils, and external indication on the forehead. 3d. The relations of the internal spine, and longitudinal groove or fossa to the brain.

OS ETHMOIDES.

Situation. Anterior part of the floor of the cranium betwixt the orbitary plates of the frontal bone, and from which it depends into the nostrils and walls of the orbit.

Form. Cubical and peculiarly light and spongy, from the thin plates and numerous cells of which the bone is composed.

Division. It consists first of a quadrilateral horizontal plate (the cribriform), and processes that extend from that plate; of these, one ,the crista galli is turned upwards, and three, the perpendicular lamella, and the two lateral cellular masses turned downwards to the nose.

Processes. Crista galli, wings of crista galli, perpendicular plate, os planum, turbinated bone of Morgagni or superior turbinated bone, middle turbinated.

Depressions. Of three kinds—foramina, meatus or grooves and cells. *Foramina*—olfactory, cæcum (part of), anterior internal orbitary (part of), posterior internal orbitary (part of). *Grooves.* Superior meatus of nasal fossa, middle meatus of nasal fossa. *Cells*, anterior ethmoidal, posterior ethmoidal.

The relationship which this bone bears to the brain, to the nostrils, to the orbits, and to the external bones of the nose, ought to be particularly studied.

MIDDLE CRANIAL CINCTURE.

The *middle cranial cincture* is formed by five bones, the two parietal bones which close in the circle above—the two temporal which lie at the sides, and the sphenoid which finishes it below.

OS PARIETALE.

Situation. Superior part of the cranium between the frontal and occipital bones.

Form. Quadrilateral and presenting two surfaces—an external and an internal: four margins—an anterior, a posterior, a superior, and an inferior, and four angles, a frontal, an occipital, a temporal, and a mastoidean.

Processes. Parietal protuberance, spinous process or temporal angle, semicircular ridge.

Depressions. 1st. *Foramen*—Parietal. 2d. *Canal*:—spinous, in the young subject a groove. 3d. *Fossæ*:—parietal, longitudinal.

OS TEMPORIS.

Situation.—Lateral and inferior part of the cranium between the parietal and sphenoid bones.

Form.—Irregular, but susceptible of a threefold division: the *squamous*, the *mastoidean*, and the *petrous*, each of which should be studied as a distinct bone. The first is semicircular, thin, and scaly, and overlaps the lower margin of the parietal bone: the second conical, or nipple-like and protuberant, from the cells it contains, is situated at the posterior inferior part of the squamous; and the petrous, so called from its extreme density, of a triangular pyramidal form, juts from the other two portions into the cranium, and is also remarkable for containing in its interior the organ of hearing.

Processes. 1st, *From the squamous division:* zygomatic; roots of zygomatic; 2d, *From the petrous:* styloid, vaginal, auditory.

Depressions. Five kinds. Foramina, canals, grooves, fissures, fossæ. *Foramina*—Mastoid, stylo-mastoid, which is the inferior aperture of a canal; lacerum basis cranii (part of), lacerum posterius (part of). *Canals*—Hiatus Fallopii, internal auditory, aqueductus vestibuli, aqueductus cochleæ, stylo-mastoidean, carotid, Eustachian tube or itur a palato ad aurem, musculo-auricular tube, external auditory. *Groove.* Digastric. *Fissure*—Glenoid. *Fossæ*—Glenoid, jugular.

Muscles attached. To the squamous portion, the temporalis, the masseter: *to the mastoidean portion* the sterno-mastoid, the splenius, the trachelo-mastoid and digastricus: *to the petrous division* the stylo-glossus, the stylo-pharyngeus, the stylo-hyoideus, the levator palati and tensor tympani.

The temporal bone presents to the student many points of practical interest. The thinness, brittleness, and relations of the squamous portion to the temporal muscle and brain; the transverse root of the zygomatic process in reference to dislocation of the lower jaw; the internal cavities of the petrous portion and their relations to the cutaneous and mucous tissues, and, lastly, the relation which the petrous portion and its contained organ bears to great bloodvessels and to the brain, are all worthy of particular attention.

OS SPHENOIDES.

Situation. Base of the cranium between the occipital and ethmoid bones and stretching on each side to the temples.

Form. Irregular. Frequently, but not unaptly, compared to the form of a bat with its wings expanded.

Division. Into a *middle* part or *body*, and into *the greater* processes, three on each side; viz. the little wings, or wings of Ingrassias, the great wings, and the pterygoid processes. These parts should be examined in detail by the student, and in the order now mentioned.

The *body* of the bone presents four surfaces,—a superior, an inferior, an anterior, and a posterior, and with the exception of this last, which articulates with the occipital bone, these surfaces are marked respectively by the following *processes. Upon the superior surface:*—the horizontal lamella, tuberculum olivare, posterior clynoid, anterior clynoid, perpendicular lamella: *upon the inferior surface:* azygos, scalæ: *upon the anterior surface:* vertical crest.

The *little wings* are triangular processes that run off laterally from the horizontal lamella, and present two surfaces, a superior and an inferior or *orbitary*, and two margins, an anterior and a posterior.

The *great wings* are extremely irregular in form, but present three surfaces,—an orbitary, a temporal and a superior or cerebral: three margins,—an anterior, an external, an internal: and two extremities, an anterior and a posterior, this last terminating in a spinous process.

The *pterygoid* processes which depend like the feet of the bat, are separated each into two *lamellæ:* an *internal* terminating inferiorly in a hamular process, and into an *external lamella.*

Depressions. Four kinds. Foramina, canals, fossæ and cells. *Foramina*—optic, anterior lacerated or sphenoidal fissure, rotundum, ovale, spinale. *Canals*—Vidian, pterygo-palatine (part of). *Fossæ.* Pituitary, pterygoid cavernous. *Cells.* Sphenoidal, (usually denominated *sinuses*), spheno-ethmoidal.

Attachment of muscles. All the muscles of the eye with the exception of the obliqui inferiores, the levatores palpebrarum, temporales, pterygoidii externi and interni, buccinatores, laxatores tympani, constrictores pharyngis superiores and circumflexi palati.

Although this bone lies chiefly in the base of the cranium, and is almost beyond the reach of external violence, still it has many important relations which demand the attention of the student; for example, to the brain, to the carotid arteries, and cavernous sinuses; to the pituitary gland; to the nostrils by the sinuses; and, in a practical point of view, the relations which the little wing of Ingrassias bears to the orbit.

POSTERIOR CRANIAL CINCTURE.
OS OCCIPITIS.

Situation. Posterior part of the cranium.

Form. Trapezoidal or lozen-shaped, curved from behind forward, and much more irregular upon the external than internal surface. It presents two surfaces, an external and an internal; four margins, two of which are superior and two inferior; and four angles, a superior, two lateral, and an inferior.

Processes. Upon the external surface:—external protuberance, superior curved line, inferior curved line, external crest, condyloid, jugular eminences, cuneiform; *upon the internal surface:*—internal protuberance, internal crucial spine.

Depressions. 1st, *Foramina*—magnum, anterior condyloid, posterior condyloid, lacerum posterius (part of).

2d, *Fossæ*—anterior condyloid, posterior condyloid, basilary, inferior occipital or cerebellic, superior occipital or cerebric.

Muscles attached. The epicranii, trapezii, sterno-mastoidei, splenii, complexi, recti capitis postici majores and minores, obliqui superiores capitis, recti capitis laterales, recti capitis antici majores and minores, constrictor superior pharyngis, and sometimes constrictor medius pharyngis.

For practical purposes the student should more particularly note the relative thickness or thinness of various parts of this bone, the relation it bears to the great sinuses of the brain, and to the top of the vertebral column.

Besides these bones of the cranium, supernumerary ones (*Ossa Wormiana, triquetra*) are occasionally met with, studded along the course of the sutures, more particularly the lambdoidal. They vary remarkably in size, form, and number, each being formed by a distinct centre of ossification, and in process of time they coalesce with the contiguous bones.

THE BONES OF THE FACE.

The bones of the face are 14 in number, 13 of which belong to the upper immovable part, usually called the upper jaw, and the remaining piece constitutes the lower jaw Of those of the upper jaw, some meet and unite in the mesial line, and others are placed at a greater or less distance from this line. These bones may, therefore, be arranged as follows:—

1st, Facial bones that meet and unite in the mesial line.

Ossa nasi.
Ossa maxillaria superiora.
Ossa palatina.
Vomer.

Usually viewed as single, but really consisting of two plates, which unite in the mesial line.

2d, Facial bones, separated to a greater or less distance from the mesial line.

Ossa ungues or lachrymalia.
Ossa malarum.
Ossa turbinata inferiora.

The lower part of the face consists of a movable piece, usually called the lower jaw, or the

Os maxillare inferius.

OSSA NASI.

Situation. Middle part of the face, immediately under the frontal bone, where they constitute the mesial part of the arch of the nose.

Form. Quadrilateral, narrower in the middle than at the two extremities, and much thicker superiorly than inferiorly. Each bone presents two surfaces, an external and an internal; four margins, a superior, an inferior, an internal or mesial, and external or posterior. The manner in which these bones are implicated with the contiguous bones, should be observed, and their relationship to the nasal cavity, and more indirectly to the brain particularly noted.

Muscles attached. Fronto-nasalis, compressor naris.

OSSA MAXILLARIA SUPERIORA.

Situation. Middle part of the face, of which they constitute the principal part.

Form. Broad and semicircular inferiorly, becoming more quadrilateral as we ascend, and terminating superiorly in a process which is rooted into the forehead. Each bone is remarkable for a cavity or large cell (antrum highmorianum or maxillary sinus) which exists in its interior, and to which all the other parts of the bone may be viewed as having a direct or indirect relation. This cavity has the form of a four-sided pyramid, the base of which is turned to the nostril, and the apex to the malar bone. Of the four sides, one is superior or orbitary, another inferior or alveolar, a third anterior or facial, and a fourth posterior or zygomatic.

Processes. Alveolar, anterior nasal spine, ascending or nasal plate with its transverse ridges, orbitary plate, malar eminence, tuberosity, palatine plate.

Depressions. 1st, Foramina—infra-orbitary, incisivum.

2d, *Canals*—Infra orbitary, lachrymal (part of), posterior dental, anterior dental, anterior nasal.

3d, *Fissures*—Spheno-maxillary (part of), palato-maxillary.

4th, *Fossæ*—Canine, myrtiform.

Muscles attached. Levator labii superioris alæque nasi, compressor naris, obliquus inferior oculi levator anguli oris, depressor alæ nasi, buccinator, constrictor superior pharyngis, orbicularis palpebrarum, pterygoideus externus and masseter.

As this is the principal bone of the face, the student should get thoroughly acquainted with every part of it. He should more particularly examine the relations of the antrum, to the *orbit*, to the *nose*, to the palate, to the alveolar arch and teeth, to the face and cheek-bone.

OSSA PALATI.

Situation. Posterior part of the palate, from which they ascend along the outer walls of the nostril to the orbit.

Form. Resembling somewhat the letter L, and each susceptible of a division into five portions,—a palatine, a pterygoid, a nasal, a sphenoidal, and an orbitary. These are usually described as the *processes* of the bone. When the two bones are placed in situ, the *posterior nasal spine* is formed.

Depressions. 1st, *Foramina:* posterior palatine, or inferior aperture of the posterior palatine canal, spheno-palatine (part of), pterygo-palatine (part of). *Cell*—palatine.

Muscles attached. The pterygoidei externi and interni, buccinatores, constrictor pharyngis superior, circumflexi palati and azygos uvulæ.

VOMER.

Situation. In the septum of the nose, of which it forms a considerable part.

Form. A quadrilateral thin plate resembling a ploughshare, and presenting two surfaces, one turned to the right nostril, and the other to the left; and four margins—a superior, an inferior, an anterior, and a posterior.

OSSA LACHRYMALIA OR UNGUES.

Situation.—Anterior part of the inner wall of the orbit.

Form—Quadrilateral, and remarkably thin, like scales of bone. Each presents two surfaces—an external or orbitary, and internal or nasal; four margins—a superior, an inferior, an anterior, and a posterior. The bone is farther remarkable for a groove upon its external surface, which assists in transmitting the tears into the nostril.

OSSA MALARUM.

Situation.—Lateral part of the middle of the face.

Form.—Quadrilateral, approaching to the rhomboidal, but bounded by curved lines. Each presents three *surfaces*—a facial, an orbitary, and a zygomatic: four *angles*—a superior, an inferior, an anterior, and a posterior: and four *margins*—an anterior superior, or orbitary; a posterior superior, or temporal; an anterior inferior, or maxillary; and a posterior inferior, or zygomatic.

Depressions.—1st, *Fossæ*, temporal (part of), zygomatic (part of), orbitary (part of).

2d, *Foramen.*—Malar.

3d, *Fissure.*—Spheno-maxillary (part of).

Muscles Attached.—Zygomaticus major and minor, and masseter.

OSSA TURBINATA INFERIORA.

Situation.—Inferior part of the external walls of the nostrils, from which they depend.

Form.—Elliptical, convoluted outwards, and connected to the walls of the nostril only by their superior margins. Each bone presents two surfaces—an external and an internal; two margins—a superior and an inferior; and two extremities—an anterior and a posterior.

Processes.—Hamular, anterior ascending, posterior ascending.

OS MAXILLARE INFERIUS.

Situation.—Lower part of the face, of which it forms the inferior boundary.

Form.—It has often been compared to a horse's shoe, or to the letter U. It consists of a semioval horizontal part, and of the vertical plates that stretch upwards from the extremities of the semioval portion.

The semioval portion presents two surfaces, an anterior and a posterior; and two margins, a superior or alveolar, and an inferior.

The vertical plates are quadrilateral, and present two surfaces, an external and an internal, and four margins, an anterior, a posterior, a superior, and an inferior.

Processes.—Symphysis menti, mental eminence, external oblique line, internal oblique line, internal spine, alveolar arch, base, angle, coronoid, condyloid.

Depressions.—1st, *Fossæ*, mental, submaxillary, sublingual, alveoli. *Foramina*—mental, inferior maxillary. *Canal*—inferior maxillary.

Muscles Attached.—Levatores menti, depressores labii inferioris, depressores angulorum oris, buccinatores, digastrici, mylohyoidei, genio-hyoidei, genio-hyoglossi, constrictor superior pharyngis, masseter, pterygoidei externi and interni, temporales, platysmata myoidea.

Every process of this bone ought to be examined with great care by the student. The bone is liable to many accidents and diseases requiring prompt treatment and the performance of formidable operations, and its relations to the soft parts are numerous and important.

OS HYOIDES.

Situation.—Upper and anterior part of the neck at the root of the tongue, and suspended by ligaments from the styloid processes of the temporal bones.

Form.—Semioval and curved backwards, resembling the Greek letter υ; hence its name. It is susceptible of a simple division into a middle part or *body*, and into four cornua, two cornua majora, and two cornua minora.

Muscles attached.—Digastrici, mylo-hyoidei, genio-hyoidei, genio-hyo-glossi, hyo-glossi styloglossi, constrictor medius pharyngis, sterno-hyoidei, omo-hyoidei, thyro-hyoidei.

Second Division of the Skeleton.

THE TRUNK.

The bones of the trunk may be viewed as consisting of primary and secondary pieces.

The *primary* bones are the *vertebræ*, so united together as to form a strong elastic pillar, called the *spine*, to which all the other bones are either directly or indirectly attached, and adapted, at the same time, for lodging and protecting an important central organ of the nervous system—the spinal cord.

The *secondary* bones are the ribs and sternum, which, when joined to the vertebral column, form the thorax or chest, or an osseous encasement, well adapted for the protection of the internal organs of the circulation of the blood, and of respiration.

THE SPINE, OR VERTEBRAL COLUMN.

The student should first examine the spine as a *whole*, and then direct his attention to different pieces that enter into its formation. He should note, in the first place, the number of the osseous pieces, or *vertebræ*, as they are called, in the whole column, and in the different *regions* of it, as in the *cervical*, *dorsal*, *lumbar*, *sacral*, and *coccygeal*. He should also observe the difference that exists in the sacral and coccygeal regions, or column of the *false* vertebræ, as these lower parts are denominated, from the other and higher part of the spine, which receives, from its greater capability of motion, the appellation of the column of the *true* vertebræ. But this is not all, the student must observe not only the general form, but must study in succession the different surfaces, or aspects, of the column ; the anterior, posterior, and lateral aspects; the *anterior* smooth surface, adapted for the contact of delicate organs; the *posterior* marked by a series of spinous processes: *the lateral* by a corresponding number of transverse processes, and foramina conjugalia, which communicate with a central canal, which lodges the spinal cord, and to which canal all the other parts of the spine are in some measure subservient. He should note, also, the curvatures, and observe their uses in the economy of man.

INDIVIDUAL BONES OF THE SPINE.

In investigating this part of anatomy, we might, 1st, attend to the characters *common* to the vertebræ generally ; 2nd, to those *peculiar* to the different classes of vertebræ, as the cervical, dorsal, lumbar, sacral, and coccygeal ; and, lastly, those characters proper to each vertebra.

1st.—*Characters that appertain to the Vertebræ generally, more particularly to the True Vertebræ.*

We find in the vertebræ, 1st, an anterior part, or *body;* 2nd, a spinous process, with its two laminæ ; 3rd, two transverse processes ; 4th, four articulating processes ; 5th, two bridges, or pedicles, that connect the *body* with the other processes; 6th, four *notches*, indented on the upper and lower margins of the *bridges ;* and, 7th, a *canal*, which forms a part of the general canal of the spine.

2d.—*Characters peculiar to the different Classes of Vertebræ.*

1st. The *cervical* vertebræ are easily distinguished by their small size, by the laminæ upon their bodies, by the shortness and bifurcated state of their spinous processes, by the foramen in their transverse processes, forming, by their union, a canal for the vertebral arteries.

2nd. The *dorsal*, or *costal* vertebræ, have, among other distinguishing marks, *costal impressions;* generally six of such impressions are found on each vertebræ, viz. four on *the body*, and one on each transverse process.

3rd. The *lumbar* vertebræ are distinguishable by their massiness, by the breadth of the bodies, by the depth and horizontal direction of their spinous processes, and by the ball and socket form of their articulating processes.

4th. The *sacral* vertebræ need no specification, as they are soon united to form one bone—the sacrum.

5th. The *coccygeal* vertebræ also unite, and ultimately form a single piece—the coccyx.

3d.—*Characters peculiar to each Vertebra.*

Of the *seven cervical* vertebræ, the first, the second, and the seventh have strong distinctive characters; but the third, fourth, fifth, and sixth differ only in relative size; they increase in size from above downwards.

The First Cervical Vertebra, or Atlas.

Forms a circle of bone, presenting neither body nor spinous process. It may be viewed as consisting of an anterior arch, a posterior arch, and intermediate articulating shoulders, each with a transverse process.

The Second Cervical Vertebra, or Axis.

The grand peculiarity of this vertebra is the tooth-like process which surmounts the body of the bone, and the broad horizontal articulating shoulders for the contact of the first vertebra.

The *Seventh cervical* vertebra, or vertebra prominens, is chiefly remarkable for its size, and the length and thickness of its spinous process.

The *Twelve dorsal* vertebræ are distinguished from each other chiefly, though not exclusively, by their relative size. The four superior, which resemble, in some respects the cervical, *decrease* in size from above downwards, and from the fourth to the twelfth inclusive they regularly *increase* in size. The *first*, the *tenth*, the *eleventh*, and the *twelfth* of these vertebræ can be easily distinguished by the *peculiarity* of their costal impressions, and which must be carefully noted by the student.

The *five lumbar* vertebræ are distinguished chiefly by their relative size, increasing gradually from above downwards. The *fifth*, differing from the others in greater flatness, in the less developed conditions of its spinous process, and in the greater strength of its transverse process.

SACRUM.

Situation: Posterior part of the Pelvis, between the lumbar and coccygeal vertebræ.

Form: Triangular and curved, the concavity being forward.

It presents two surfaces—an anterior and a posterior: two lateral margins: a base and a summit.

Processes: Bodies, spinous, transverse, two articulating, cornua, promontory.

Depressions: 1st, *Foramina*—four pairs of anterior sacral, four pairs of posterior sacral, sacro-coccygeal (part of); 2nd, *Fossæ*—auricular; 3rd, *Canal*—sacral.

Muscles attached. Latissimi dorsi, longissimi dorsi, sacro-lumbales, multifidi spinæ, obliqui interni abdominis, glutei, maximi, pyriformes and coccygei.

COCCYX.

Situation: Posterior inferior part of pelvis, terminating the spine inferiorly.

Form: Triangular, presenting two surfaces—an interior and a posterior; two lateral margins; a *base*, turned to the sacrum, and an apex which is free, and turned forwards.

Processes: Transverse, cornua.

Muscles attached. Glutei maximi, coccygei, levatores ani, sphincter ani.

Muscles attached to the column of the true vertebræ:—They are placed in the following order: *posteriorly* are found the m. trapezii, latissimi dorsi, rhomboidei majores et minores, levatores scapulæ, serrati postici superiores et inferiores, splenii, sacro-lumbales, longissimi dorsi, spinales dorsi, cervicales descendentes, transversales colli, trachelo-mastoidei, complexi, recti capitis postici majores et minores, obliqui capitis superiores et inferiores, semispinales dorsi, semispinales colli, multifidi spinæ, intertransversales et interspinales colli, dorsi et lumborum, obliqui abdominis interni. On the *anterior region*—m. longi colli, recti capitis interni majores et minores, recti capitis laterales, diaphragma, quadrati lumborum, psoæ magni et parvi. *Laterally*, m. scaleni antici, medii et postici, and the transversales abdominis.

Besides the *osseous* pieces that enter into the formation of the spine, there are elastic fibro-cartilages, which connect these pieces, and permit, at the same time the requisite degrees of motion; but these parts ought to be studied along with the ligaments.

From the extremely complicated structure of the spine, and its numerous relations to muscles, blood-vessels, nerves, and vital organs, it demands the special investigation of the student. If he understand thoroughly the osseous part of the spine, a knowledge of its other textures will easily be acquired; for all the other textures are intimately related to the bones, and modified by the form and capability of motion in the osseous pieces.

The Secondary Bones of the Trunk consist of the Ribs and Sternum.

THE RIBS.

The ribs, generally twelve in number, on each side are osseous arches, that extend from the dorsal region of the vertebral column. The seven superior are attached through the medium of the costal cartileges to the sternum, and called *sternal* or *true* ribs, and the five inferior, *spurious*, *false*, or *asternal*, as they have no connection with that bone. The eleventh and twelfth ribs take the name also of *floating* ribs, as they are generally free at their anterior extremities, and lie, as it were, floating among the muscles.

Some characters are *common* to the ribs *generally*, and others *peculiar* to each rib.

The character *common* to the ribs are—arched form, a flattening from side to side, each rib presenting two surfaces, an external and internal ; two margins, a superior and an inferior ; an articulating surface, or head; a neck; a tubercle; an angle; a groove; a sternal extremity. These characters, although common, do not all appertain to every rib.

Each rib has something *peculiar* in regard to length, breadth, obliquity of position with regard to the spine, degree of curvature, and in the modification or deficiency of some of the common characters. The ribs most peculiar in these respects are the first, second, eleventh and twelfth.

STERNUM.

Situation : Anterior part of the thorax.

Form.—Elongated, flat, broader above than at the middle, and terminating inferiorly in a point. It presents two surfaces—an anterior and a posterior : three margins—a superior and two lateral ; the superior thick, notched mesially, and more laterally adapted for the reception of the sternal ends of the clavicles; the lateral margins presenting seven cup-like cavities for the reception of the costal cartilages. At the period of adult age, the bone consists of three pieces, a superior, a middle, and an inferior, called ensiform appendix, or cartilage.

Muscles attached.—Pectorales majores, sterno mastoidei, sterno-hyoidei, sterno-thyroidei, sterno-costales, recti abdominis, intercostales, interni and diaphragma.

The thorax, as a *whole*, should be studied also with great care. Its form, its dimensions, longitudinally through its axis—from spine to sternum, and from side to side, should be particularly observed. The form and size of its base—of its truncated apex, and of the intercostal spaces, should be scrutinised; and the student should render himself familiar with every projection and cavity upon its external surface, as well as the arrangement of its parts internally.

Third Division of the Skeleton

Consists of the Upper and Lower extremities.

I.—THE UPPER, OR THORACIC, EXTREMITY

Consists of four grand subdivisions; 1st, a shoulder; 2nd, an upper arm; 3rd, a fore-arm; and, 4th, a hand.

BONES OF THE SHOULDER.

Two bones exist in this subdivision of the limb—the clavicle anteriorly, and the scapula behind.

CLAVICULA.

Situation.—Anterior part of the shoulder, stretching between the sternum and scapula.

Form.—Slender, curved like the italic letter *S.*, but more round and protuberant at the sternal than scapular extremity. It presents two surfaces—a superior and an inferior; two margins—an anterior and posterior; and two extremities—a sternal and a scapulary: the latter extremity placed more posteriorly than the former.

Muscles attached.—Subclavius pectoralis major, deltoides, trapezius, sterno-mastoideus.

SCAPULA.

Situation.—Posterior part of the shoulder, extending from the first to the seventh rib.

Form.—Triangular, broad, presenting two surfaces—a posterior or dorsal, and an anterior; three margins—a superior, an anterior, and a posterior or base; and two angles—a superior and an inferior.

Processes.—Spine, acromion, coracoid.

Depressions.—1st. *Fossæ*—supra-spinata, infra-spinata subscapularis, glenoid cavity, neck; 2nd. *Notch*—semilunar, or suprascapular.

Muscles attached.—Supra spinatus, infra spinatus, teres minor teres major, trapezius, deltoides, subscapulares, omo-hyoideus levator scapulæ, coraco-brachialis, biceps, pectoralis minor, triceps, rhomboideus minor and major, serratus anticus, latissimus dorsi.

BONE OF THE UPPER-ARM, OR HUMERUS.

Situation.—Extends from the scapula to the elbow joint.

Form.—Cylindrical, rounded, and protuberant superiorly, and more flat inferiorly. Like all the long bones, it may be viewed as consisting of *three* parts, a superior, or proximal extremity, a shaft, or body, and an inferior, or distal extremity. At the *superior* extremity of the bone we find a head or articulating surface, a neck for the attachment of ligamentous fibres, and two tuberosities, an external or greater, and an internal or smaller, separated by the bicipital groove.

The *shaft* presents three ridges, one, which descending from the *great tuberosity*, is lost before it reaches the lower part of the bones, and two, confined to the sides of the lower part of the bone. These ridges impart a threefold, longitudinal direction to the shaft, as if it presented three surfaces—an external, internal, and posterior.

The *inferior* extremity of the bone is marked by eminences and depressions. The eminences are of two kinds: 1st. *articular*, as the trochlea and radial head; and, 2d. *non-articular*, as the external and internal condyle; and the depressions are two, an anterior coronoid, and a posterior olecranoid.

Processes.—Head, great tuberosity, little tuberosity; external lip of bicipital groove, deltoid impression; internal lip of bicipital groove, anterior margin, two lateral margins, condyles, trochlea, inferior or radial head.

Depressions.—Anatomical neck, surgical neck, bicipital groove, coronoid fossa, olecranoid fossa.

Muscles attached.—1st, *To its upper extremity.* Supra spinatus infra spinatus, teres minor, subscapularis.

2nd. *To its Shaft.* Deltoid, coraco-brachialis, pectoralis major, teres, major, latissimus dorsi, brachialis anterior, biceps, supinator longus and extensor carpi radialis longior.

3rd. *To the lower extremity.* Extensor carpi radialis brevior, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris, anconeus, supinator brevis, pronator teres, flexor carpi radialis, palmaris gracilis, flexor carpi ulnaris, flexor sublimis.

Bones of the Fore-arm;

OR RADIUS AND ULNA.

RADIUS.

Situation.—External margin of the fore-arm stretching from the lower extremity of the humerus to the carpal bones near the root of the thumb.

Form.—Cylindrical, slender, smaller superiorly than inferiorly and bent slightly towards the ulna. It presents superiorly a small rounded button-like *head*, dimpled for the reception of a process of the humerus; immediately below we find the neck, and somewhat lower still the *bicipital tuberosity.* The *shaft* of the bone, commencing at this point, presents three surfaces—an anterior, a posterior, and an exterior; and three margins—an anterior, a posterior, and a sharp internal one, turned towards the ulna. The *lower extremity* of the bone is much more protuberant than the superior; and besides the two articulating surfaces which it displays—one for the reception of the carpal bones, and another for articulating with the lower extremity of the ulna, it presents a styloid process: and grooves for the transmission of tendons and muscles.

Processes. Head, bicipital tuberosity—styloid.

Depressions. 1st. *Foramina*—Nutrient. 2d. Fossæ—&c. Humeral, neck, inferior ulnar, scaphoid.

Muscles attached. Supinator longus and brevis, pronator teres, biceps, flexor longus pollicis, pronator quadratus, flexor sublimis digitorum, extensor primus pollicis.

ULNA.

Situation. Inner side of the fore-arm parallel with the radius and stretching from the humerus to the carpus, near the root of the little finger.

Form. Prismatic and triangular and much thicker superiorly than inferiorly. At the upper extremity we find two articulating cavities:—the great and the little sigmoid, for articulating respectively with the humerus and radius: and two processes, the *olercanon* and *coronoid.* The *shaft* of the bone presents 3 surfaces, an anterior, a posterior, and an internal: and 3 margins, an anterior, a posterior, and a sharp external one turned to the radius. At the *lower extremity* we find 2 processes, a rounded articular surface the carpal head, which both articulates with the radius and is turned to the carpal bone: and 2d, a styloid process.

Processes—Olecranon, coronoid, margins, carpal head, styloid. *Fossæ*—Great sigmoid cavity, little sigmoid. *Foramen*—Nutrient.

Muscles attached. Brachialis anterior, flexor carpi ulnaris, flexor profundus, and sublimis, pronator quadratus ; flexor carpi radialis, supinator brevis, pronator teres, anconeus, triceps, extensor carpi ulnaris, extensor primus, secundus, and tertius pollicis, extensor indicis.

HAND.

The *articulated* hand should *first* be examined by the student and then the pieces of which it consists in detail. He should observe the *form* of the hand—its convex *dorsal* surface, its concave or *palmar* surface : its radial margin corresponding with the thumb : its ulnar margin or that of the little finger : its upper or brachial extremity formed for articulating with the bones of the fore-arm, and its digital extremity formed by the ends of the fingers.

The hand is farther susceptible of 3 grand subdivisions—the carpus, metacarpus, and phalanges or fingers. The *carpus* consisting of 8 small bones so allocated as to form two rows, a superior and an inferior, four bones existing in each row. These bones are, in the *superior* or *brachial row*, the scaphoid, the semilunar, the cuneiform and the pisiforme. *In the inferior row*, the trapezium, the trapezoides, the os magnum, and the unciform.

The *metacarpus* consists of five bones of an elongated form, extending side by side from the carpal bones and designated either by their numerical names counting from the thumb to the little finger, as first, second, &c., or by the name of the fingers which they support.

The *fingers* 5 in number, are usually counted from the thumb to the little finger. They are often referred to also by their proper names, viz. the thumb, the fore-finger, the mid-finger, the ring-finger and the little finger. Each finger consists of more than one elongated bone—the thumb of two bones besides its metacarpal, and each of the other fingers of three such bones, hence we speak of the first and second bones of the thumb, and the first, second, and third bones or phalanges of the smaller fingers.

After the student has extended his knowledge of the hand thus far he must go more minutely to work and get a knowledge of the *individual bones*, so that he may be able to distinguish them easily from each other. This knowledge can only be obtained by a practical examination of the bones. The bones of the *carpus* are distinguished generally by the peculiarity of their forms, and their names to some extent indicate that peculiarity.

The *metacarpal* are much more easily distinguished by the difference of form existing in their superior extremities, and the phalanges are distinguished, the first and second by the peculiarity of their articulating extremities, and the last by their form.

Muscles attached to the carpus. 1*st. To the os pisiforme* flexor carpi ulnaris and abductor minimi digiti. 2*d. To the trapezium*—flexor ossis metacarpi pollicis, flexor brevis pollicis, abductor pollicis and semi interosseus. 3*d. To the os trapezoides*—Part of the flexor brevis pollicis. 4*th. To the os magnum*—Flexor brevis pollicis. 5*th. To the os unciforme*—Flexor brevis minimi digiti, abductor ossis metacarpi m. digiti.

Muscles attached to the metacarpus. To the first metacarpal bone, flexor ossis metacarpi pollicis, semi interosseus, extensor primus pollicis.

To the second metacarpal bone. Semi interosseus, second palmar interosseus or posterior indicis, prior medii, flexor carpi radialis, extensor carpi radialis longior.

To the third metacarpal bone. Prior medii, posterior medii, abductor pollicis and extensor carpi radialis longior.

To the fourth metacarpal bone. Posterior medii, posterior annularis.

To the fifth metacarpal bone. Interosseus auricularis, flexor ossis metacarpi minimi digiti, extensor earpi ulnaris.

Attachment of muscles to bones of the fingers.

To the thumb. Abductor, opponens, flexor brevis, abductor flexor longus, extensor secundus, and tertius pollicis.

To the fore-finger. Semi interosseus, first lumbricalis, adductor, part of extensor communis digitorum, flexor sublimis and profundus digitorum.

To the mid-finger. Prior and posterior medii, second lumbricalis, part of extensor communis digitorum—part of flexor digitorum sublimis and profundus.

To the ring-finger. Prior and posterior auricularis, third lumbricalis, part of extensor communis digitorum, part of flexor digitorum sublimis and profundus.

To the little finger. Abductor, flexor brevis, interosseus auricularis, lumbricalis, extensor proprius, part of extensor communis, flexor sublimis and profundus.

In studying the *bones of the Superior Extremity*, the student should turn his attention very particularly to the articulating surfaces of these bones, as these constitute the key to the osteology and myology of the limb, and this knowledge is conducive to many important purposes in the practice of surgery.

INFERIOR OR PELVIC EXTREMITY.

In the great subdivisions of the limb, the inferior extremity strikingly resembles the superior; it consists of four similar subdivisions,—a haunch, a thigh, a leg, and a foot. The haunch consists of three bones in the young subject—a superior, the ilium; an inferior, the ischium: and an anterior, the pubes, which with age are united into one piece, and denominated the

OS INNOMINATUM.

Situation. Lateral and anterior part of the pelvis, of which it forms a considerable part.

Form. Quadrilateral, narrower in the middle than at the two extremities, and twisted. It presents two surfaces—an external and an internal; and four margins—a superior, an inferior, an anterior, and a posterior.

Processes. On the external surface: superior gluteal line, inferior gluteal line, brim of the acetabulum cavity. *On the internal surface:* tuberosity of the erest, linea ilio-pectinea, inclined plane of ischium, superior margin or erest of ilium, inferior margin or descending ramus of pubes, and ascending ramus of ischium. *On the anterior margin:* anterior superior spinous process of ilium, anterior inferior spinous proeess of ilium, ileo-pectineal eminence, spine of pubes, angle of pubes. *On the posterior margin:* posterior superior spine of ilium, posterior inferior spine of ilium, spine of ischium, tuberosity of ischium.

Depressions. Dorsum of the ilium, cotyloid or acetabulum cavity, obturator foramen, iliac fossa, auricular surface, ischiatic notch.

Muscles attached. 1st, *To external surface:* gluteus maximus, medius, minimus, tensor vaginæ femoris, curved head of the rectus femoris, obturator externus, adductor longus, brevis and magnus.

2d, *To internal surface:* iliacus internus, obturator internus, levator ani.

3d, *To superior margin:* obliquus externus et internus abdominis, transversalis abdominis, latissimus dorsi, quadratus lumborum, longissimus dorsi, sacro lumbalis.

4th, *To inferior margin:* gracilis, erector penis or clitoridis, transversus perinei.

5th, *To anterior margin:* sartorius, rectus femoris, psoas parvus, pectineus, rectus, pyramidalis.

6th, *To posterior margin:* gemini, ischio-coccygeus, quadratus femoris, biceps, semi-membranosus, semi-tendinosus.

By the union of the ossa innominata with the sacrum and coccyx, an *osseous circle* of great importance is formed, denominated

THE PELVIS.

This part of the skeleton cannot be too carefully examined by the student. He should direct his attention to the following particulars :—The form of the pelvis : its external surface, and the relations of the acetabulum cavity to the various parts of this surface : its internal surface, and its division into an upper and lower cavity ; the form and dimensions of the upper cavity; the form and dimensions more particularly of the lower cavity or pelvis commonly so called ; its brim or inlet, and extent of its various diameters ; its inferior aperture or outlet, and its various diameters ; its depth all round the cavity ; the axis of the brim ; the axis of the outlet ; the external circumference of the whole pelvis, superiorly and inferiorly.

The student should also compare the male and female pelvis, and note their differences in size, strength, configuration, &c.

FEMUR.

Situation. In the thigh, stretching from the pelvis to the leg.

Form. Cylindrical, longer, stronger, and heavier than any other bone in the body ; it consists of the following parts—a head or ball—a neck—a shaft or body and two condyles, an external and internal.

Processes. Besides the subdivisions of the bone above mentioned, we find on the *shaft* the trochanter major, trochanter minor, anterior inter-trochanteral line, posterior inter-trochanteral line, linea aspera, external and internal branches of *superior* bifurcation of linea aspera, external and internal branches of *inferior* bifurcation of linea aspera, tuberosities of condyles.

Depressions. Digital cavity of trochanter major, trochlea, inter-condylar fossa.

Muscles attached. To trochanter major : gluteus medius minimus, pyriformis, gemini, and obturatores. To *trochanter minor :* psoas magnus and iliacus internus. To *shaft:* quadratus femoris, pectineus, gluteus maximus, adductor brevis, longus, and magnus, biceps, vastus externus, vastus internus and crureus. To *condyles :* gastrocnemius extr., popliteus and plantaris.

In the *Leg*, three bones are found, two of which run parallel—the tibia and fibula ; the tibia forming the principal bone of the leg, and the fibula placed along its outer side like a surgical splint ; the third bone, the patella, is more connected with the knee than the leg, and may be viewed as an appendage of the tibia.

TIBIA.

Situation. Internal part of the leg, extending from the femur to the foot.

Form. Triangular and prismatic, and much more expanded superiorly than inferiorly. It consists, 1st. Of an upper extremity for the reception of the condyles of the femur; 2dly. Of a shaft, presenting three surfaces—an internal, an external, and a posterior; and three margins—an anterior or crest, an internal, and an external; and, 3dly, of an inferior extremity, chiefly adapted for the attachment of the foot.

Processes. Superior spine, crest, tuberosity of the crest, malleolus internus.

Depressions. Femoral, superior fibular impression, inferior fibular, astragaloid fossa.

Muscles attached. Sartorius gracilis, semitendinosus, semimembranosus, popliteus, soleus, flexor communis digitorum, tibialis posticus, tibialis anticus, extensor pollicis, extensor communis digitorum.

FIBULA.

Situation. External part of the leg, extending somewhat obliquely along the external part of the tibia, from the upper extremity of that bone to the foot.

Form. A long slender bone, the upper extremity rounded and protuberant, the lower expanded and flattish, and the shaft marked by ridges that take a somewhat spiral course. The bone consists of an upper extremity; of a shaft that presents three surfaces—an external, an internal, and a posterior; and three ridges or margins—an external, an internal, and a posterior; and of a lower extremity.

Processes. Head, neck, ridges, inferior extremity or malleolus externus.

Muscles attached. Biceps cruris, extensor longus digitorum, extensor proprius pollicis, peroneus tertius, peroneus longus and brevis, soleus, tibialis posticus, and flexor longus pollicis.

PATELLA.

Situation.—Anterior part of the knee joint, and connected to the upper part of the tibia by the patellar ligament.

Form.—Triangular, presenting two surfaces—an external and an internal; two lateral margins; a base turned upwards; and an apex connected to the tibia by the patellar ligament.

Muscles attached.—Rectus femoris—cruræus, vastus externus and vastus internus.

FOOT.

This is the most complicated subdivision of the bones of the lower limb, and will require the undivided attention of the student. In studying this part of anatomy, he should first direct his attention to the foot as a *whole*, and then he will be prepared to examine each piece in detail. The following points demand his consideration:—The form of the foot; its superior or dorsal surface; its inferior or plantar surface; its inner or tibial margin, corresponding with the great toe; its outer or fibular margin, that which corresponds with the little toe: its posterior or calcaneal extremity, formed by the heel bone; its anterior or digital extremity, formed by the points of the toes and its connection with the bones of the leg.

The foot, like the hand, must be farther viewed as consisting of three grand subdivisions—the *tarsus*, the *metatarsus*, and the *toes:* the tarsus consisting of seven bones curiously connected; the metatarsus of five bones; and the toes of fourteen bones or phalanges, besides the two supernumerary ossa sessamoidea.

Having made himself acquainted with the great outlines of the foot, the student must next proceed to a closer and more minute examination of each bone. He must learn to distinguish *each* bone and every surface, both articulating and non-articulating which each presents.

The *tarsal* bones may be arranged into a superior and internal or tibial range, and into an inferior and external or fibular range. In the first we find the astragalus, the os naviculare, and three cuneiforme bones—an inner, a middle, and an external; and in the second, the os calcis and os cuboides.

The *metatarsal* bones, five in number, are elongated bones, extending side by side from the tarsal bones to the toes, and indicated most frequently by their numerical names, counting from the great toe towards the little toe.

The *toes*, five in number, are usually referred to by their numerical names; the great toe being the *first*, counting them in succession to the little toe, which is the *fifth*. Each toe consists of three bones, with the exception of the great toe, which has only two; hence we refer to the first and second bone of the great toe, and the first, second, and third phalanges or bones of the smaller toes.

The bones of the tarsus can be easily distinguished by the peculiarities of form and differences in size.

The metatarsal resemble each other more strikingly both in form and size, but they can be easily distinguished by the peculiarities of form of their posterior articulating extremities.

The bones of the *toes* can be distinguished by their relative size, by the peculiarities of their articulating extremities, and by their forms.

Muscles attached to the Tarsus.—Gastrocnemius, soleus, plantaris, tibialis posticus, flexor brevis digitorum, adductor pollicis, flexor brevis minimi digiti, and flexor brevis pollicis pedis, extensor brevis digitorum, abductor and flexor brevis pollicis, abductor minimi digiti, flexor digitorum, accessorius, tibialis anticus, peroneus longus.

Muscles attached to the Metatarsus.—Interossei, transversalis pedis, tibialis anticus, peroneus longus, adductor pollicis pedis, peroneus brevis, abductor and flexor brevis minimi digiti pedis.

Muscles attached to the Toes.—Extensor longus and brevis digitorum pedis, interossei, flexor longus and brevis digitorum pedis, lumbricales, flexor longus and brevis pollicis pedis, abductor pollicis, and extensor longus pollicis pedis.

OSSA SESSAMOIDEA.

Situation.—Connected with certain joints of the fingers and toes. *Number.*—Usually two are found in each of the metacarpo-digital and metatarso-digital articulations respectively of the thumb and great toe.

Form.—They vary both in form and size, but resembling usually, as the name denotes, the sessamum seed.

A *Skeleton*, properly so called, does not exist in invertebrated animals, although that appellation has been given to some of the harder textures of these animals by some comparative anatomists. These hard textures are the parts *analogous* to the skeleton of higher animals, and adapted for similar uses, and found sometimes on the exterior, and in other instances in the interior of the animal. When placed externally, even though unorganised, they increase with the growth of the animal of which they form as it were an appendage. The hardness of these skeletons, or skeleton-like textures in all animals, is attributable to certain earthy substances which in various ways are incorporated with the animal textures. These earthy materials are not the same in all animals, yet they do not present such a variety as the appearance of different animals would lead us to suppose. Silica, carbonate of lime, or phosphate of lime, only, enters into their composition. In the lowest of the radiated animals, silica is found ; in the molluscous classes, carbonate of lime ; carbonate and some phosphate of lime in the articulated animals; and in the vertebrated animals, the phosphate of lime constitutes the chief, almost the sole ingredient.

The most complicated and perfect skeletons are found in the vertebrated animals. In all such animals the bones are numerous and highly organised, yet they vary remarkably in number, in physical and chemical properties as well as form, in the different classes, orders, genera, and species, and to the chief of these differences we shall now briefly refer.

1st, Diversities exist in the *number* and disposition of pieces composing the skeleton. In the ophidian reptiles, the skeleton consists of a head and trunk, the limbs are wanting. In the batrachian reptiles we find no ribs, and the spine is defective. In cetaceous animals a cartilaginous tail takes the place of posterior extremities, and the anterior, though existing, are curtailed of their fair proportions and converted into fins. In fish, the extremities are found uniformly under the form of fins, and some fish want these appendages in a greater or less degree.

2d, Diversities exist in the *connection* and *relationship* of the bones of the skeleton. In many animals, all the bones of the skeleton are closely connected by ligaments. In many, a less close connection exists, and in various degrees. In some animals the os hyoides is the only insulated piece. In others, the clavicles lie floating among the muscles. In others, the upper extremities are wholly ununited; and the bone of the penis of many mammalia, and the bony circle of the sclerotica of birds, and the muscular bones of many fishes, are directly connected with no other osseous part.

3d, Diversities exist in the *colour* of bones. The bones in all animals are generally of a white or whitish colour. In some fish, as the garpike, they are green, and in some varieties of the common fowl they are black. (*Blumenbach*).

4th, The *structure* of bone varies in different classes of animals, and in the same animal at different periods of life. In the higher animals the bones are cancellated and filled with an oleaginous fluid, the marrow, which varies in consistency in different animals. In the bones of birds, the marrow is generally wanting: they are usually light and dry, and hollow, for containing atmospheric air. In mammalia and birds the bones are smooth, fine and dense in the grain or texture. In reptiles they exhibit a coarser texture, and in fishes they have a softer, more transparent, and horny appearance from the greater quantity of gelatine they contain.

SECTION SECOND.—OF THE ARTICULATIONS.

An articulation is formed by the natural apposition of two or more bones.

All the articulations of the human body may be arranged into two classes: 1st, the immovable; and, 2d, the movable. The immovable, formed by the direct contact of bones, so knit together as to admit of no perceptible motion, and the movable formed generally (though not in every instance) by osseous pieces, with intervening and adventitious connecting media, and moulded, and otherwise adapted for a variety of motions. The *Immovable* junctions are found exclusively in the cranium, and are effected in one of three ways. 1st. In some, by the direct and mutual penetration of opposite margins; 2d, by a small degree of mutual penetration, and by the overlapping of one of the bones over the other; and, 3d, by a small degree of mutual penetration, and by the *mutual* overlapping of opposite bones.

2d. The *movable* articulations are of two kinds—the capsular and non-capsular, or those joints that are lubricated by the secretion of a synovial capsule, or secreting apparatus, and those in which that apparatus is not required, and is consequently awanting. Between these kinds of joints there is a broad line of demarcation. The one is complex in structure, and the other comparatively simple. In the former, motion is performed by the gliding of smooth and free surfaces upon each other, while in the latter motion is permitted by the elasticity of a connecting intermedium. The osseous junctions of the upper and lower limbs are exemplifications of the first, and those of the pelvis and vertebral column of the second.

In the capsular articulations, the following textures are found: 1st, bone; 2d, cartilage; 3d, synovial membrane; 4th, ligament, and in some few, fibro-cartilage.

The *osseous* parts of the joints are beautifully moulded to each other. Their articulating surfaces present less variety than might at first view be supposed. They are formed in one of two ways, either by surfaces, one of which is simply convex, the other correspondingly concave, although the *degree* of concavity and convexity may vary in different joints, from surfaces almost flat, to the well-formed ball and socket; or, 2dly, by surfaces, which though convex and concave, like the former, are more complicated, the convex surface being also traversed by a groove, and the concave by a corresponding ride. All the pulley-like joints, commonly called hinge-joints, are of this kind.

The articulating surfaces of bones are covered with *Cartilage*,* a solid, polished, and very elastic substance, of a pearly white colour; and although apparently of a homogeneous structure, its *fibrous* and laminated texture may be demonstrated by maceration. The fibres of articulating cartilages are found uniformly to run in the same direction as those of the bone from which they emanate, and to become soft towards their free or synovial extremities.

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* Cartilage, like bone, consists of animal and mineral matter; the animal matter consisting of very condensed cellular membrane, blood-vessels, and probably nerves and absorbents, although the low degree of vitality which it enjoys has led many to doubt the existence of these last textures: the mineral matter consists of the phosphate of lime.

The chemical composition of cartilage, according to Sir Humphrey Davy, is the following:—albumen, 44·5; water, 55·0; and phosphate of lime, 0·5.

Cartilages are divided into the temporary and permanent—the first, forming the nidus for bones, disappears with the development of the osseous texture: the second, not subject to the osseous transformation, is found under three conditions in the body—1. Where it forms organs, as the larynx, ribs, &c.; 2. Where it enters into the structure of the joints; and 3. Where it lines grooves, and depressions in bones for facilitating the motion of tendons.

The *synovial* capsule is an essential part of these articulations. It consists of a shut sac, in many instances, of extreme delicacy, that adheres firmly, and adapts itself, to the parts it is intended to lubricate; while non-adhering surface is turned to the interior of the joint, and secretes the *synovia.* This fluid, so denominated from its resemblance to the white of egg, is transparent, viscid, and heavier than water.

Its chemical analysis, according to Sir Humphrey Davy, is as follows:—

Two parts of synovia contains water 98·3; gelatine and mucilage ·93; albumen ·53; muriate of soda ·23, with traces of fixed alkali and phosphate of lime.

Although the synovial membranes connect the bones as well as secrete and contain the synovia, still the principal connecting parts are the *ligaments.*

The *Ligaments* are firm and elastic bundles of fibres of a silvery-white colour, arranged in a parallel direction, strengthened by cross fibres, and imbedded in cellular membrane. The ligamentous texture is adapted, by its great strength for retaining the bones in apposition, and counteracting the forces that tend to their displacement. The ligaments exist under three modifications—the orbicular, or purse-like; the flat; and the cord-like; the first encase certain joints, the second found under different forms, as the triangular, quadrangular, strengthen, and protect large portions of the synovial apparatus; and the third, by their rope-like qualities, are almost exclusively adapted for binding the bones firmly together.

The *fibro-cartilages* are so denominated because they partake of the property both of the fibrous and cartilaginous textures; possessing the flexibility of the one, and the elasticity of the other. This texture, consisting of cartilage, embedded in a densely fibrous tissue, is found entering, 1st, into the formation of organs, as the alæ of the nose, eyelids, external ear, and trachea; 2d, into the structure of the articulations; and, 3d, into canals, for the transmission of the tendons of muscles. The interarticular fibro-cartilages are formed of concentric laminæ, and are generally thickest at the part turned to the circumference of the articulation. Some of them, besides, separate completely, and others only partially, the bones between which they are placed.

It is difficult to assign a satisfactory use to the articular fibro-cartilages. They have been supposed to facilitate motion, by acting like friction wheels in machinery; but they are not peculiar to joints susceptible of the greatest motion, or subjected to the greatest pressure. They are found only in the following joints: the temporo-maxillary, the sterno-clavicular, the ulno-carpal, and the femoro-tibial; but none of these joints enjoy the latitude of motion of the shoulder joint, or pressure of the tibio-tarsal articulation. They probably serve three purposes—1st, to deepen articulating sockets; 2d, to facilitate motion; and, 3d, to increase the extent of the synovial surface of the joints.

The following is a list of all the movable joints of the body, Capsular and Non-capsular, with a notification of the ligaments entering into each joint.

Temporo-Maxillary.—Ligaments: capsular, external lateral, internal lateral. *Accessary ligaments:* stylo-maxillary, inter-maxillary, internal fibro-cartilage.

Hyoideal.—Ligaments: stylo-hyoideal.

Vertebro-Cranial, or 1st Cervico-Vertebral.—Ligaments: capsular, anterior, posterior.

Atlo-Axoidal.—Ligaments: capsular, transverse of the atlas, odontoid.

Vertebral.—Ligaments: capsular, anterior common vertebral, posterior common vertebral, inter-vertebral, supra spinous, yellowish, inter-spinous.

Sacro-Coccygeal.—Ligaments: anterior, posterior.

Ilio-Sacral.—Ligaments: ilio-lumbar, great sacro-sciatic, little sacro-sciatic, anterior and posterior sacro-iliac.

Pubic.—Ligaments: inter-pubic, sub-pubic, anterior pubic.

Costo-Vertebral.—Ligaments: capsular, radiated, internal, 1st, 2d, and 3d transverse.

Costo-Sternal.—Ligaments: capsular, anterior, posterior.

Sterno-Clavicular.—Ligaments: capsular, anterior, posterior, inter-clavicular, costo-clavicular, inter articular fibro-cartilage.

Cleido-Scapular.—Ligaments: capsular, superior, conoid, trapezoid.

Brachio-Scapular, or Shoulder Joint.—Ligaments: capsular, coraco-humeral, glenoid. *Adventitious ligaments:* triangular deltoid coracoid.

Brachio-Cubito-Radial, or Elbow Joint.—Ligaments: capsular, internal lateral, anterior, posterior.

Radio-Ulnar.—Ligaments: superior capsular, annular, round, interosseous, inferior capsular, triangular fibro-cartilage.

Radio-Carpal, or Wrist-Joint.—Ligaments: capsular, external lateral, internal lateral, anterior, posterior.

Carpal.—Ligaments: (*Of brachial range,*) inter scapho-lunar, posterior scapho-lunar, anterior scapho-lunar, inter luno-pyramidal, anterior luno-pyramidal, posterior luno-pyramidal, pyramido-pisiformal. (*Of digital range,*) anterior trapezo-trapezoidal, posterior trapezo-trapezoidal, inter-trapezo-trapezoidal, anterior trapezoido-magnal, posterior trapezoido-magnal, inter trapezoido-magnal, anterior magno-unciformal, posterior magno-unciformal, inter magno-unciformal. (*Con-*

mon to both ranges,) anterior carpal, posterior carpal, external lateral, internal lateral, capsular.

Carpo-Metacarpal.—Ligaments: capsular, anterior, posterior.

Metacarpal.—Ligaments: Capsular, 3 superior anterior transverse, 3 superior posterior transverse, inferior transverse.

Metacarpo-Digital.—Ligaments: capsular, external lateral, internal lateral, 1st, 2d, 3d, and 4th anterior.

Digital.—Ligaments: capsular, external lateral, internal lateral, anterior.

Ilio-Femoral, or Hip-Joint.—Legaments: capsular, teres, cotyloid.

Femoro-Tibial or Knee-Joint.—Ligaments: capsular, patellar, posterior, external lateral, internal lateral, adipose, anterior crucial, posterior crucial, external semilunar fibro-cartilage, internal semilunar fibro-cartilage, anterior transverse.

Fibulo-Tibial.—Ligaments: superior capsular, anterior superior, posterior. superior, interosseous, anterior triangular, posterior triangular, inferior interosseous.

Tibio-Peroneo-Tarsal, or Ankle-Joint.—Ligaments: capsular, internal lateral, anterior external lateral, middle external lateral, posterior external lateral.

Tarsal.—Ligaments: capsular, external astragalo-calcaneal, posterior astragalo-calcaneal, inter astragalo-calcaneal, external calcaneo-scaphoideal, inferior calcaneo-scaphoidal, astragalo-scaphoidal, superior calcaneo-cuboidal, inferior calcaneo cuboidal, inter scaphoido-cuboidal, superior scaphoido-cuboidal, superior cuboido-cuneiformal, inferior cuboido-cuneiformal, scaphoido-cuneiformal superior (1st, 2d, 3d), scaphoido-cuneiformal inferior (1st, 2d, 3d), superior cuneiformal (1st, 2d), inferior cuneiformal (1st, 2d.).

Tarso-Metatarsal.—Ligaments: capsular, 1st, 2d, 3d, 4th, 5th dorsal, 1st, 2d, 3d, 4th, 5th plantar.

Metatarsal.—Ligaments: 3 dorsal—3 plantar.

Metatarso-Digital.—Ligaments: capsular, internal lateral, external lateral, inferior.

Digital.—Ligaments: capsular, external lateral, internal lateral, anterior.

PART II.

THE MUSCULAR SYSTEM.

The muscular system consists of an assemblage of organs, denominated muscles, by which the motions of the body are performed. Each muscle has properties common to the muscular system, and others peculiar to itself. The first are those appertaining to the muscular tissues generally; and the second are those dependent on the peculiarity of situation and use.

The *muscular texture* is a peculiar substance, arranged in the form of fibres of extreme slenderness. When examined by the naked eye, soon after death, these fibres are soft but solid; and in the human being, though not in all animals, of a reddish colour. They are placed close together, and usually parallel to each other. Generally speaking, this texture is arranged in one of two ways: first, in masses of various forms and sizes; and secondly, in thin layers. The muscles of voluntary motion, or those that move the bones, are of the first kind: and the involuntary muscles, or those concerned in the vital actions, are of the second description. By examining a muscular fibre with the microscope, it is seen to consist of a vast number of minuter fibres, which are called filaments. Prochaska, who has devoted much of his time to the investigation of this subject, maintains that the ultimate filament of the muscular fibre is discernible with a good microscope; and he says that it is always, and in every muscle of every animal, of the same magnitude. He calculates its size to be about 1-5th part of the diameter of the red globule of the blood. Some physiologists, however, believe that *no* elementary or ultimate muscular filament exists; and they farther maintain that there is *no end* to the subdivision of the filament, but the imperfection of our senses and the instruments we employ. As the infinite divisibility of matter is a doctrine now generally rejected by philosophers, it is extremely probable that the division of the muscular fibre stops at the point indicated by Prochaska, and that this filament possesses all the physical, chemical, and physiological properties of the muscular texture. These filaments are first laid together in such numbers as may form a *fibre;* fibres thus formed are joined together so as to constitute larger fibres or bundles (fasciculi); and by the union of these larger bundles or fasciculi, the muscles so called are produced.

Prochaska states, as the result of his observations, that the ultimate or primary muscular filaments are naked, or not covered by cellular texture. This does not hold good with regard to the *fibres* and *fasciculi*; cellular membrane obviously connecting them together, and constituting, altogether, a large portion of every muscle. By cutting any muscle across, we can easily demonstrate the relation which the cellular membrane bears to the muscle as a whole, and to its fasciculi and fibres. We observe, 1st, a layer which surrounds the whole muscle; 2d, processes which are detached from the inner surface of this general sheath, and form smaller sheaths for the *fasciculi;* and lastly, similar prolongations proceeding from the sheaths of the fasciculi surround the fibres. Cellular membrane then forms the connecting medium of every subordinate part of a muscle (if we except, upon the authority of Prochaska, the ultimate filaments), in the same manner as it binds together the fleshy masses that form collectively the muscular system.

The microscopic observations of Bauer and Sir E. Home, of Prevost and Dumas, and Beclard, lead to the conclusion that the ultimate muscular filament is composed of globules, like the central part of the globules of the blood, deprived of their colouring matter, and arranged in a lineal manner, connected by a transparent gelatinous-like substance. We have no reason to believe, however, that these globules are hollow or vesicular, or consist of the termination of vessels or nerves, or are formed by any modification of the cellular texture, but that they consist, or enter into the formation of a texture, sui generis, and which consequently possesses peculiar vital powers.

The muscular fibre is plentifully supplied by arteries, veins, lymphatics, nerves, and cellular membrane, but little is known regarding the disposition of these textures upon the ultimate muscular filament.

The *colour* of muscle varies in different animals, and in different parts of the same animal. In man it is red or reddish. In many animals whitish or of a light grey colour; and the slender fibres that form the muscular tunic of the intestines almost colourless. It is extremely probable that the colour of muscle depends not upon the blood contained in the muscle, but on some principle in chemical combination with the fibre, and on which the peculiar smell as well as colour of the muscles in different animals depends.

The *consistency* of muscle varies also from causes that act both before and after death. In the dead subject we generally find it soft, moist, pliant, possessing little elasticity, and easily torn; although in the living subject, during action, it is hard, and its cohesive power or strength very great.

Chemical analysis shows that muscle is composed of fibrine, albumen, gelatine, osmazome, and saline substances. The saline matters are common to it, with other organic substances; and fibrine in large quantity, and albumen and osmazome in smaller proportions, form the peculiar proximate principles of muscle.

Without adverting to the effects produced upon the muscular fibre by the action of chemical re-agents, we cannot but impress upon the mind of the student the propriety of carefully attending to that chemical process by which muscle is converted into *adipocere*, as highly curious in itself, and calculated to lead to practical conclusions.

A muscle is a fleshy mass formed by the aggregation of a number of fleshy fasciculi, and connected to bones or the hard parts by tendinous or aponeurotic fibres. Among the muscles a great variety of *form* exists, but it is doubtful if any classification will embrace all their peculiarities.

We might make a general division into the *elongated* and the *flat*, as they differ in situation and the mode generally by which they are attached to bones. The *flat* are chiefly found on the head and trunk, and the *elongated*, which are usually also more or less rounded, are more confined to the extremities or limbs. In the flat muscles, besides, the tendons in which they terminate are generally membranous or aponeurotic, while the tendons of the long muscles are rounded and slender, and often of considerable length, and thus capable of transferring the power which exists in the fleshy belly to a more distant part of the body or limb.

With a few exceptions, each muscle, then, consists of two parts: 1. A *fleshy* portion, which is the proper muscular part, and from which the power emanates; and, 2. A *tendinous* or tendinous parts, which advantageously connect the muscular part to the osseous, and concentrate, diffuse, or transmit to a distance the moving power.

Tendons are fibrous textures of a silvery whiteness, possessing some elasticity and much strength. Each tendon has two extremities, one of which is generally buried in the muscle, and the other attached to the bone. The fibres of tendon resemble those of ligament, but arranged somewhat differently; there is in the tendon more twisting and intertwining of the fibres, and probably more strength. It is surrounded also like ligament by a cellular investment, and not unfrequently protected from the effects of friction by *bursæ mucosæ* or synovial capsules, which lie between the tendons and hard parts over which they may glide.

In each muscle we recognise two *ends* or extremities, and a *middle* part or *belly*. The most fixed or least movable of these extremities is its head, more frequently called its *origin*, and the opposite extremity, or the most movable one, its *insertion*.

The *names* of the muscles are formed upon no single principle; some are derived from the circumstance of *situation*, as epicranius, intercostal; some from *form*, as orbicularis quadratus; some from *the direction* of the fibres, as recti, obliqui; some from the *bones* to which they are attached, as sterno-cleido-mastoideus; some from *use*, as flexors, extensors, abductors, adductors, &c.

In the living subject, muscles are found in one of two states, that of relaxation and that of contraction. Relaxation is the quiescent or passive state of a muscle. Upon the application of a stimulus, the muscle passes from a passive to an active condition; its surface, which before was smooth and soft, now becomes wrinkled and hard to the touch: its belly swells out, while its ends approximate, and the whole muscle is rendered shorter and thicker. This state can continue for a very short period only, when it more or less gradually disappears, and terminates in absolute relaxation. A *transition* state must be passed through by a muscle, before its contraction can end in *perfect relaxation*. Its belly becomes soft, its swelling subsides, its opposite extremities separate, and the whole resumes its natural appearance, but not without the assistance of other powers, as antagonist muscles, the elasticity of surrounding parts, or the influence of gravity.

Muscular action is induced by two sets of causes: 1. The will in the voluntary muscles; and, 2. Chemical and mechanical stimuli in both voluntary and involuntary muscles.

The general use of the muscles is easily stated: they are the great organs of motion; of that by which the whole body is moved from place to place; of that by which each of its separate parts is moved when we act upon contiguous bodies in our intercourse with the world; and also that by which the more minute and imperceptible actions of the living system are performed.

The bones are acted upon by the muscles after the manner of *levers*; so that the *insertion* of a muscle corresponds with the *power*, the joint with the *fulcrum*, and the part to be moved with the *weight*. Numerous exemplifications of the three kinds of levers are found in the body, more particularly of the third kind, by which, although strength to a certain extent is sacrificed, quickness of motion is obtained.

The *proximate cause* of muscular contraction is involved in obscurity, and the investigations of physiologists have not tended to expel the darkness.

Before the student commence the practical examination of the muscles, supposing he has attained a thorough knowledge of the bones, he should endeavour to form an idea of the general appearance and situation of the muscles from the dissection of others.

After he has thus been made familiar with the great outlines of the subject, he will require to dissect each muscle, commencing at the upper part of the body, and proceeding regularly and systematically downward, till he has overtaken them all.

The muscles may be arranged into three grand subdivisions: 1. Those of the head; 2. Those of the trunk; and, 3. Those of the limbs; and each of these again into subordinate *regions.*

The *Head*, so far as the muscles are concerned, may be viewed as presenting four aspects: 1. A superior; 2. An anterior or facial; 3. A lateral on each side; and, 4. An inferior or basilary; and on each aspect the following *regions:* on the *first*, the epicranial; on the *second*, the superciliary, the palpebral, the orbital or ocular, the nasal, the superior labial, the buccal, the inferior labial, and the oral; on the *third*, the aural, the temporal, and zygomatic; and on the *fourth*, the palatine and lingual.

The *Trunk* may be viewed like the head, as consisting of *four aspects:* 1. An anterior; 2. A posterior; 3. A lateral on each side; and, 4. An inferior; each presenting the following muscular *regions. Anteriorly*, the superficial cervical, the infra-hyoideal, the supra-hyoideal, the laryngeal, the pharyngeal, the anterior cervico-vertebral, the anterior thoracic or pectoral, the abdominal, the diaphragmatic and lumbar. *Posteriorly*, the dorsal. *Laterally*, the lateral cervico-vertebral, the lateral thoracic, and the intercostal. *Inferiorly*, the genital in the male, the genital in the female, and the anal.

The *muscular regions* of the *extremities* are similar to those of the skeleton. In the upper extremity we have the scapular, the brachial, the radio-ulnar or region of the fore-arm, and carpo-metacarpo-digital, or region of the hand; and in the inferior *extremity*, the gluteal, the femoral, the tibio-peroneal, or region of the leg, and tarso-metatarso-digital, or region of the foot.

The following arrangement is a short notification of the *origin*, *insertion*, and *use* of each muscle, according to the foregoing arrangement.

SPECIAL ANATOMY OF THE MUSCLES.

In a full description of any muscle, the following particulars require to be notified:—1st, The *name* of the muscle, and its synonymes when they exist. 2d, *Its situation.* 3d, *Its form.*

4th, *Its attachments*, or, in other words, its *origins* and *insertions*. 5th, *Its direction*, or the course of the muscle as a *whole*. 6th, *Its relations*, or relative position to the parts in contact with it. 7th, *Its structure*, or the anatomical composition of the muscle, or the relationship and disposition of its muscular and tendinous parts. And, 8th, *Its uses*.

In the lecture-room all these particulars receive due consideration; but in these pages we shall, for the sake of brevity, note, and in as few words as possible, only the most important points in each muscle; viz. its *name*, *origin*, *insertion*, and *use*, except when, from their peculiar importance, other particulars require to be noticed.

I. DIVISION.—MUSCLES OF THE HEAD.

I.—EPICRANIAL REGION.

Occipito-Frontalis.—Origin. Two external kinds of the superior curved line of the occipital bone, and mastoidean process of the temporal bone. *Insertion.* Eyebrow. *Use.* To elevate the eyebrow and move the scalp.

II.—SUPERCILIARY REGION.

Corrugator Supercilii.—Origin. Internal angular pro. of frontal bone. *Insertion.* Middle of eyebrow where it is confounded with the occipito-frontalis, and orbicularis palpebrarum muscles. *Use.* To carry the eyebrow towards the root of the nose.

III.—PALPEBRAL REGION.

1. *Orbicularis Palpebrarum.—Origin.* 1st, ascending plate of the sup. maxillary bone—2d, tarsal tendon—3d, internal angular process of the frontal bone. *Insertion.* As this muscle consists principally of circular fibres, its origin and insertion may be viewed as united. *Use.* To approximate the eyelids.

In dissecting this muscle the student should note the arrangement of its fibres—1st, upon the eyelids—2d, around the base of the orbit—and 3d, observe the relationship of its tendon to the lachrymal sac.

2. *Levator Palpebræ Superioris.—Origin.* Roof of the orbit near the margin of the optic foramen. *Insertion.* Superior margin of the tarsal cartilage of upper eyelid. *Use.* To raise the upper eyelid.

3. *Tensor Tarsi.—Origin.* Os unguis. *Insertion.* By two portions, along the inner part of the free margins of the eyelids. *Use.* To compress and empty the lachrymal canals.

IV.—OCULAR REGION.

1. *Rectus Superior Oculi.—Origin.* Superior margin of the optic foramen. *Insertion.* Superior aspect of the sclerotic coat of the eye, about two lines from the cornea. *Use.* To turn the eye upwards.

2. *Rectus Inferior Oculi.—Origin.* Body of the sphenoid bone. *Insertion.* Inferior aspect of the sclerotica, about two lines from the cornea. *Use.* To pull the eye downwards.

3. *Rectus Internus Oculi.—Origin.* 1st, body of the sphenoid bone—2d, margin of the optic foramen. *Insertion.* Nasal surface of the sclerotica, about two lines from the cornea. *Use.* To move the eye towards the nose.

4. *Rectus Externus Oculi.—Origin.* In common with the two preceding muscles. *Insertion.* External aspect of the tunica sclerotica, about two lines from the cornea. *Use.* To carry the eye outwards.

5. *Obliquus Superior Oculi.—Origin.* Body of the sphenoid bone, near the optic foramen. *Insertion.* After passing through the pulley at the internal angular process of the frontal bone, into the posterior external part of the sclerotica, about three lines from the optic nerve. *Use.* It draws the eye towards the pulley, and at the same time turns the cornea downwards, and towards the nose.

6. *Obliquus Inferior Oculi.—Origin.* Orbitary plate of the maxillary bone, near the lachrymal groove. *Insertion.* External part of the sclerotica, about two lines from the optic nerve. *Use.* To draw the eye forwards and inwards, and at the same time to direct the cornea upwards and outwards.

V.—NASAL REGION.

1. *Fronto-Nasalis.—Origin.* Anterior margin of the occipito-frontalis muscle. *Insertion.* Transversalis nasi muscle. *Use.* Wrinkles the skin of the nose.

2. *Transversalis Nasi.—Origin.* Nasal side of the canine fossa. *Insertion.* 1st, its fellow upon the dorsum of the nose—2d, fronto-nasalis muscle. *Use.* To contract as well as to dilate the anterior apertures of the nostril.

3. *Levator Labii Superioris Alæque Nasi.—Origin.* External surface of the nasal plate of the superior maxillary bone, immediately below the tendon of the orbicularis palpebrarum muscle. *Insertion.* 1st, wing of the nose—2d, upper lip. *Use.* To raise the upper lip and expand at the same time the nostril.

VI.—SUPERIOR LABIAL REGION.

Superficial Layer.

1. *Levator Labii Superioris Proprius.—Origin.* Superior maxillary and malar bones, immediately above the infra orbi-

tary foramen. *Insertion.* Upper lip. *Use.* Raises the upper lip.

2. *Zygomaticus Minor.—Origin.* External surface of the os malæ. *Insertion.* Upper lip, near the angle of the mouth. *Use.* To draw the superior lip upwards and outwards.

3. *Zygomaticus Major.—Origin.* External surface of the os malæ, near the zygomatic suture. *Insertion.* Angle of the mouth. *Use.* Raises the angle of the mouth, and carries it backwards.

Deep-seated Layer.

1. *Depressor Labii Superioris Alæque Nasi.—Origin.* Fossa myrtiformis. *Insertion.* 1st, cartilage of the ala of the nose—2d, cartilaginous septum of the nose. *Use.* Draws the cartilaginous part of the nose and the upper lip downwards.

2. *Levator Anguli Oris.—Origin.* Canine fossa, below the infra orbitary foramen. *Insertion.* Angle of the mouth. *Use.* To carry the angle of the mouth upwards and inwards.

VII.—INFERIOR LABIAL REGION.

The muscles in this region are so arranged, that the *first* overlaps the *second*, and the second to a still greater degree the *third.*

1. *Depressor Anguli Oris.—Origin.* External oblique line of the lower jaw. *Insertion.* Angle of the mouth. *Use.* Draws down the angle of the mouth.

2. *Depressor Labii Inferioris.—Origin.* External oblique line of the lower jaw. *Insertion.* Lower lip. *Use.* Draws down the lower lip.

3. *Levator Menti.—Origin.* External surface of the lower jaw, below the sockets of the incisor teeth. *Insertion.* Skin of the chin. *Use.* Raises the chin and lower lip.

VIII.—BUCCAL REGION.

Buccinator.—Origin. 1st, external surface of the superior alveolar arch, from the last tooth to the second bicuspidatus—2d, a corresponding portion of the inferior alveolar arch—3d, pterygo-maxillary aponeurosis. *Insertion.* Angle of the mouth. *Use.* Pulls the angle of the mouth backwards, and by diminishing the cavity of the mouth, produces various effects.

As the duct of the parotid gland transmits the saliva into the mouth through this muscle, the student should particularly observe the course and relationships of this tube, from the anterior margin of the parotid gland, till it opens into the mouth opposite the second molar tooth of the upper jaw.

IX.—ORAL REGION.

Orbicularis Oris.—A circular muscle of the mouth that forms the margin of the lips. *Use.* Approximates the lips, and closes completely the mouth.

X.—AURICULAR REGION.

External Muscles.

1. *Superior Auriculæ.—Origin.* Aponeurosis of the occipito-frontalis muscle. *Insertion.* Posterior surface of the concha of the external ear. *Use.* Raises the external ear.

2. *Anterior Auriculæ.—Origin.* External margin of the occipito-frontalis muscle. *Insertion.* Anterior part of the helix. *Use.* Draws the external ear forwards and upwards.

3. *Posterior Auriculæ.—Origin.* Base of the mastoid process of the temporal bone. *Insertion.* Inferior part of the convexity of the concha of the external ear. *Use.* Draws the external ear backwards.

4. *Hellicus Major.*—Situated along the superior convex part of the helix.

5. *Helicus Minór.*—Situated on the commencing or horizontal part of the helix.

6. *Tragicus.*—Confined to the external surface of the tragus.

7. *Antitragicus.*—Covering the internal surface of the antitragus.

8. *Transversus Auris.*—Crossing the dorsal aspect of the auricle.*

Internal Muscles.

9. *Tensor Tympani.—Origin.* Rough part of the inferior surface of the petrous portion of the temporal bone—2d, cartilage of the Eustachian tube. *Insertion.* The angle formed by the junction of the handle with the neck of the malleus. *Use.* By dragging the malleus inwards, to render tense the membrana tympani.

10. *Laxator Tympani.—Origin.* 1st, spinous process of the sphenoid bone—2d, cartilage of the Eustachian tube. *Insertion.* Processus gracilis of the malleus. *Use.* To draw the malleus outwards, and thus to relax the membrana tympani.

11. *Stapedius.—Origin.* Cavity of the pyramid. *Insertion.* Neck of the stapes posteriorly. *Use.* To press the stapes upon the membrane of the fenestra ovalis.

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* These five last-mentioned muscles are very indistinctly marked, and their uses not clearly understood.

XI.—TEMPORAL REGION.

By removing the muscles of the ear and lower margin of the occipito-frontalis, the student will find a dense aponeurotic membrane, the fascia of the temporal muscle, which should be carefully cleaned, and its attachment to the boundaries of the temporal fossa, and to a part of the external surface of the temporal muscle, particularly observed.

Temporalis.—Origin. Temporal fossa. *Insertion.* Coronoid process of the lower jaw. *Use.* To bring the lower jaw in contact with the upper, as in masticating food.

XII.—ZYGOMATIC REGION.

Superficial Layer.

Masseter.—Origin. Inferior margin and internal surface of the zygoma. *Insertion.* External surface of the ascending plate, and angle of the lower jaw. *Use.* To raise the lower jaw.

Deep-seated Muscles.—Behind ascending Plate of the Lower Jaw.

1. *Pterygoideus Externus.—Origin.* External surface of the external lamina of the pterygoid process of the sphenoid bone—2d, external surface of the tuberosity of the palatine bone—3d, inferior part of the temporal surface of the sphenoid bone. *Insertion.* 1st, condyle of the neck of the lower jaw—2d, anterior margin of the inter-articular fibro-cartilage. *Use.* To carry the condyle and inter-articular cartilage forwards, and to throw the chin to the opposite side. When the two act in concert, the jaw is carried directly forwards.

2. *Pterygoideus Internus.—Origin.* Fossa pterygoidea. *Insertion.* Internal surface of the ascending plate and internal margin of the angle of the lower jaw. *Use.* To pull the jaw obliquely towards the opposite side, and when both act, to raise the jaw, and carry it forwards.

XIII.—PALATINE REGION.

The *velum pendulum palati* must be studied before the muscles in this region can be comprehended. The student must observe the kind of partition which this fleshy curtain forms between the mouth and pharynx. He should note its *form*, its *anterior surface* turned to the mouth: its *posterior surface* turned to the pharynx: its *superior margin*, adherent to the posterior margin of the hard palate; its *inferior*, or *free margin*, with the *uvula* like a nipple projecting downwards to the middle line of the tongue; and the *anterior* and *posterior arches* of the fauces, extending laterally from the uvula, the anterior to the tongue, and the posterior to the pharynx, and by their divergence leaving a triangular space for the lodgment of the *tonsils*.

1. *Constrictor Isthmi Faucium.—Origin.* Lateral part of the root of the tongue. *Insertion.* Velum palati. *Use.* To draw down the velum palati, and raise the root of the tongue.

2. *Palato-Pharyngeus.—Origin.* 1st, the thyroid cartilage —2d, the lateral part of the pharynx. *Insertion.* The velum palati. *Use.* To draw down the velum, and to raise the pharynx and larynx.

3. *Circumflexus Palati.—Origin.* 1st, sphenoid bone immediately above the pterygoid fossa—2d, cartilaginous part of the Eustachian tube. *Insertion.* It turns round the hamular process of the sphenoid bone to be attached, 1st, to the palatine bone—2d, stretches into the velum. *Use.* To spread out the velum palati.

4. *Levator Palati Mollis.—Origin.* 1st, inferior surface of the petrous portion of the temporal bone—2d, cartilaginous part of the Eustachian tube. *Insertion.* Velum palati. *Use.* To raise the velum palati.

5. *Palato-Staphylinus, or Azygus Uvulæ.—Origin.* Posterior nasal spine. *Insertion.* The uvula. *Use.* To raise the uvula.

XIV.—LINGUAL REGION.

1. *Stylo-glossus.—Origin.* 1st, styloid process of the temporal bone—2d, stylo-maxillary ligament. *Insertion.* Border of the tongue. *Use.* To draw the tongue upwards, backwards, and laterally.

2. *Hyo-glossus.—Origin.* Body and great horn of the os hyoides. *Insertion.* The lateral and posterior part of the tongue. *Use.* Depresses the tongue, and raises the os hyoides.

3. *Lingualis.*—A bundle of muscular fibres stretching from the base to the apex of the tongue, between the second and fourth muscles of this region. *Use.* Shortens the tongue, and turns its apex downwards.

4. *Genio-hyo-glossus.—Origin.* Internal spine of the chin. *Insertion.* 1st, whole length of the tongue near its mesial line —2d, little horn of the os hyoides. *Use.* To depress the tongue, to protrude as well as draw it back into the mouth. and to elevate the os hyoides.

II. DIVISION.—MUSCLES OF THE TRUNK.

I.—SUPERFICIAL CERVICAL REGION.

The muscles of the neck are implicated with a superficial and deep-seated *fascia*, the structure and attachments of which ought to be well known. The *superficial cervical fascia* is a thin layer of condensed fibro-cellular membrane, lying immediately under the skin, enclosing the platysma myoides and stretching upwards over the parotid gland, downward upon the chest, and continuous with the superficial fascia on the other parts of the body. Upon raising it, along with the platysma myoides, the *deep-seated cervical fascia* is exposed, and its dense fibrous structure is at once apparent. It surrounds the neck from the ligamentum nuchæ, enveloping the muscles and glands, and attached to the lower jaw and styloid process of the temporal bone superiorly, and to the sternum and two superior ribs inferiorly.

1. *Platysma Myoides.—Origin.* Cellular tissue covering the pectoralis major and deltoid muscles. *Insertion.* 1st, symphysis menti, inferiorly—2d, part of the external oblique line of the lower jaw—3d, muscles and skin of the lower lip and cheek. *Use.* To draw down the jaw and angle of the mouth; to wrinkle the skin of the neck; and to act as a fascia to the subjacent textures.

2. *Sterno-cleido-mastoideus.—Origin.* 1st, anterior surface of the sternum near its superior margin—2d, superior surface and posterior margin of the sternal fourth of the clavicle. *Insertion.* 1st, mastoid process of the temporal bone—2d, external third of the superior curved line of the occipital bone. *Use.* Brings the head forwards, and throws the face to the shoulder of the opposite side.

II.—INFERIOR HYOIDEAL REGION.

1st Layer.

1. *Omo-Hyoideus.—Origin.* Superior margin of the scapula, near the root of the caracoid process. *Insertion.* Inferior margin of the body of the os hyoides laterally. *Use.* To depress and carry backwards the os hyoides, and to move the scapula in the opposite direction.

2. *Sterno-Hyoideus.—Origin.* 1st, posterior surface of the upper portion of the sternum, opposite the cartilaginous attachment of the first rib—2d, capsule of the sterno-clavicular articulation. *Insertion.* Inferior margin of the body of the os hyoides. *Use.* To draw down the os hyoides.

2d Layer.

1. *Sterno-Thyrodeus.—Origin.* Posterior surface of the upper piece of the sternum opposite the cartilaginous attachment of the second rib. *Insertion.* External surface of the thyroid cartilage. *Use.* To draw down the thyroid cartilage.

2. *Thyro-Hyoideus.—Origin.* Oblique line on the external surface of thyroid cartilage. *Insertion.* 1st, body and anterior half of the great horn of the os hyoides. *Use.* To draw the larynx and os hyoides nearer each other.

III.—SUPERIOR HYOIDEAL REGION.

1st Layer.

1. *Digastricus.—Origin.* Digastric groove of the temporal bone. *Insertion.* Posterior margin of the base of the lower jaw, near the symphysis menti. It traverses the stylo-hyoid muscle, and is fixed by an aponeurosis to the anterior surface of the hyoid bone. *Use.* To depress the jaw, or elevate the os hyoides.

2. *Stylo-Hyoideus.—Origin.* Styloid process of the temporal bone. *Insertion.* Lateral part of the body of the os hyoides. *Use.* To raise the os hyoides laterally.

2d Layer.

3. *Mylo-hyoideus.—Origin.* Internal oblique line of the lower jaw, from opposite the last grinder to the symphysis menti. *Insertion.* 1st, its fellow of the opposite side—2d, anterior surface of the body of the os hyoides. *Use.* Raises the os hyoides, and draws down the jaw.

3d Layer.

4. *Genio-hyoideus.—Origin.* Internal spine of the chin. *Insertion.* Anterior surface of the body of the os hyoides. *Use.* To bring the chin and os hyoides nearer each other.

IV.—LARYNGEAL REGION.

[The muscles in this region cannot be understood till the student has obtained a knowledge of the *Cartilages* that form the skeleton of the *Larynx.* These cartilages are the *thyroid*, the *cricoid*, the *two arytenoid*, and the *epiglottis.*

Thyroid Cartilage.—Formed of two broad quadrilateral plates, united at an angle anteriorly; each plate presenting *two surfaces*, an external and internal—*three free margins*, a superior, an interior, and a posterior—and *two cornua* on each side, a superior and an inferior.

Cricoid Cartilage.—Situation. Lower margin of thyroid cartilage, but posteriorly rising within the protection of that cartilage. *Form.* Ring-like, much deeper behind than before, and presenting *two surfaces*, an external and internal—*two margins*, a superior and inferior

Arytenoid Cartilages—are two in number, placed upon the superior margin of the cricoid. *Form.* Pyramidal, the apices turned upwards, and each surmounted by a *capitulum*, which may be viewed as a distinct cartilage.

Epiglottis.—A fibro-cartilage, in form like an artichoke leaf, connected to the base of the tongue by folds of mucous membrane, and placed over the opening of the windpipe, which it can be made to close. It presents *two surfaces*, a lingual and a laryngeal; two lateral margins, and a superior extremity, which is rounded and free.

Ligaments of the Larynx.—1. The hyo-thyroid, a middle and two lateral—2. The crico-thyroid—3. Two thyro-arytenoid, or *chordæ vocales*, or inferior ligaments of the glottis.]

1. *Crico-thyroideus.—Origin.* Lateral and anterior part of the external surface of the cricoid cartilage. *Insertion.* 1st, inferior margin of the thyroid cartilage—2d, inferior cornu of the same cartilage. *Use.* Approximates the thyroid and cricoid cartilages, and pulls the thyroid forwards.

2. *Crico-arytenoideus Posticus.—Origin.* Posterior surface of the cricoid cartilage. *Insertion.* External side of the arytenoid cartilage. *Use.* Carries the arytenoid cartilage outwards and backwards, and thus enlarges the rima glottidis.

3. *Crico-arytenoideus lateralis.—Origin.* The side of the superior margin of the cricoid cartilage. *Insertion.* External and anterior part of the base of the arytenoid cartilage. *Use.* To open the rima glottidis.

4. *Thyro-arytenoideus.—Origin.* Posterior surface of the thyroid cartilage near its angle. *Insertion.* Anterior aspect of the arytenoid cartilage. *Use.* To pull the arytenoid cartilage forwards, and thus to shorten the ligament of the larynx.

5. *Arytenoideus.*—Consists of oblique and transverse fibres stretching betwixt the two arytenoid cartilages, posteriorly. *Use.* To contract and shut the rima glottidis.

6. *Aryteno-epiglottideus.—Origin.* Side of the arytenoid cartilage. *Insertion.* The epiglottis. *Use.* To carry the epiglottis over the glottis.

7. *Thyro-epiglottideus.—Origin.* Thyroid cartilage. *Insertion.* Margin of the epiglottis. *Use.* To expand the epiglottis.

V.—PHARYNGEAL REGION.

1. *Constrictor Pharyngis Inferior.—Origin.* 1st, External surface of the cricoid cartilage—2d, inferior cornu, and external oblique line of the thyroid cartilage. *Insertion.* Its fellow—both muscles constituting the posterior inferior part of the pharynx. *Use.* To contract the lower part of the pharynx.

2. *Constrictor Pharyngis Medius.—Origin.* 1st, superior surface of the great horn of the os hyoides—2d, inferior part of the little horn—3d, stylo-hyoid ligament. *Insertion.* Its fellow. *Use.* To contract the middle part of the pharynx.

3. *Stylo-Pharyngeus.—Origin.* Styloid process of the temporal bone. *Insertion.* Posterior margin of the thyroid cartilage,

implicated with the constrictor medius. *Use.* To dilate and raise the pharynx.

4. *Constrictor Pharyngis Superior.—Origin.* 1st, posterior margin of the internal pterygoid plate of the sphenoid bone—2d, pterygo-maxillary aponeurosis—3d, posterior extremity of the internal oblique line of the lower jaw—4th, root of the tongue, laterally. *Insertion.* 1st, its fellow—2d, cuneiform process of the occipital bone, inferiorly. *Use.* To contract the upper part of the pharynx.

VI.—ANTERIOR CERVICO-VERTEBRAL REGION.

1. *Rectus Capitis Anticus Major.—Origin.* Anterior tubercles of the transverse processes of the 6th, 5th, 4th, and 3d cervical vertebræ. *Insertion.* Inferior surface of the basilar process of the occipital bone anterior to the foramen magnum. *Use.* To carry the head forwards.

2. *Rectus Capitis Anticus Minor.—Origin.* The anterior part of the shoulder of the atlas near the root of the transverse process. *Insertion.* Inferior surface of the basilary process of the occipital bone nearer the condyle than the former muscle. *Use.* Nods the head upon the atlas.

3. *Longus Colli.—Origin.* 1st, bodies of the three superior dorsal, and four inferior cervical vertebræ—2d, corresponding intervertebral fibro-cartilages—3d, transverse processes of the 5th, 4th, and 3d cervical vertebræ. *Insertion.* Tubercle on the anterior arch of the atlas. *Use.* To bend the neck forwards.

VII.—LATERAL CERVICO-VERTEBRAL REGION.

1. *Rectus Capitis Lateralis.—Origin.* Anterior part of the transverse process of the atlas. *Insertion.* Jugular eminence of the occipital bone. *Use.* Carries the head forwards, when it acts with its fellow.

2. *Scalenus Anticus.—Origin.* Superior surface of the first rib. *Insertion.* Transverse processes of the 6th, 5th, 4th, and 3d cervical vertebræ. *Use.* To bend the neck forwards and to one side, and to raise the first rib.

3. *Scalenus Medius.—Origin.* Superior surface of the first rib behind the groove, formed by the transit of the subclavian artery. *Insertion.* Apices of the transverse processes of all the cervical vertebræ, with the exception of the first. *Use.* Moves the neck to the one side, and elevates the first rib.

4. *Scalenus Posticus.—Origin.* Superior margin of the second rib near the spine. *Insertion.* Posterior tubercles of the transverse processes of the 6th and 5th cervical vertebræ. *Use.* To bend the neck laterally, and backwards, and to raise the second rib.

VIII.—ANTERIOR THORACIC REGION.

1. *Pectoralis Major.—Origin.* 1st, sternal third of the anterior margin of the clavicle—2d, anterior surface of the first and second portions of the sternum—3d, Cartilages of all the true ribs, except the first. *Insertion.* External margin of the bicipital groove of the humerus. *Use.* To carry the arm in the direction of the sternum.

2. *Subclavius.—Origin.* Superior surface of the first costal cartilage. *Insertion.* Along the inferior surface of the clavicle. *Use.* To depress the clavicle.

3. *Pectoralis Minor.—Origin.* Superior margin and external surface of the 3d, 4th, and 5th ribs, near their cartilages. *Insertion.* Internal margin of the coracoid process of the scapula. *Use.* To carry the scapula forwards and downwards, or when the shoulder is fixed, to elevate the ribs and expand the thorax.

4. *Sterno-costalis.—Origin.* 1st, posterior surface of the second piece of the sternum—2d, ensiform cartilage. *Insertion.* Cartilages of the 6th, 5th, 4th, and 3d ribs. *Use.* To pull down the ribs to which it is attached, and thus to assist in expiration.

IX.—LATERAL THORACIC REGION.

1. *Serratus Major Anticus.—Origin.* External surface of the eight or nine superior ribs, by an equal number of digitations. *Insertion.* 1st, anterior surface of the scapula near its superior angle—2d, base of the scapula—3d, anterior surface of the scapula near its inferior angle. *Use.* Rolls the scapula and pulls it forward; when the scapula is fixed, expands the thorax.

X.—INTERCOSTAL REGION.

1. *Intercostales Externi.—Origin.* Inferior margin of the eleven superior ribs, from their heads to the costal cartilages. *Insertion.* Superior margin of the eleven inferior ribs. *Use.* To elevate all the ribs except the first.

2. *Intercostales Interni.—Origin.* 1st, inferior margin of the eleven superior costal cartilages—2d, inferior margin of the eleven inferior ribs, the muscles extending as far back as the angles of the ribs *Use.* To elevate all the ribs except the first.

3. *Levatores Costarum Breviores.—Origin.* Transverse processes of the last cervical and eleven superior dorsal vertebræ. *Insertion.* Upper edge of all the ribs between their tubercles and angles, each muscle passing over only one intercostal space. *Use.* To raise the ribs.

4. *Levatores Costarum Longiores.—Origin.* Transverse process of the 7th, 8th, 9th, and 10th dorsal vertebræ. *Insertion.*

The four lowermost ribs, each muscle passing over two intercostal spaces. *Use.* To raise the ribs to which they are attached.

XI.—ABDOMINAL REGION.

The muscles of the *abdominal region* should be examined with much care by the student, as they form the principal part of the walls of the abdominal cavity, and are interesting also in many surgical operations, particularly those for *inguinal* and *femoral herniæ*—to the structure of the parts concerned in which, he will require to devote much of his time and attention. He should dissect the parts of this region in the following order:—1st, *skin ;* 2d, *fascia superficialis*, or elastic cellular membrane, and "observe its external and *loose* part immediately under the skin," not unfrequently loaded with fat, and its thinner and more condensed portion that adheres more firmly to the surface of the external muscles ; 3d, the *external oblique muscles* marked by the *linea alba*, in the mesial line of the abdomen, formed by the intermixture of the tendinous fibres of the opposite flat muscles of the abdomen ; the *linea semilunaris* or semicircular white line, one on each side of the former, formed by the union of the tendinous fibres of the three flat muscles at the outer edge of the rectus muscle; and three or more *transverse white lines*, which seem at first view to belong to the external oblique, but are tendinous lines, traversing the *recti muscles*, and seen through a thin aponeurotic covering. 4. The *external inguinal opening* formed by the separation of the tendinous part of the external oblique muscle near the pubes, the spermatic cord passing through it in the male, and the round ligament in the female. 5. The *umbilicus*—its peculiarities in the fœtus for transmitting the two umbilical arteries, the umbilical vein and urachus, and its closed condition after birth ; and lastly, the student should observe the *nine* abdominal regions—the three SUPERIOR, viz., the *epigastric* or *scrobiculus cordis* and *right* and *left hypochondriac;* the three MIDDLE—the *umbilical*, and the *right* and *left lumbar ;* and the three INFERIOR—the *hypogastric* or *region* of the *bladder*, and the *right* and *left iliac.* All these important parts should be observed before the student raise up the external oblique muscle to prosecute the dissection of the deep-seated muscles of this region.

1*st Layer.*

1 *Obliquus Externus Descendens.—Origin.* External surface and lower edge of the eight superior ribs by an equal number of digitations or triangular portions. *Insertion.* 1st, into the linea alba—2d, symphysis pubis, and pubic bone of the opposite

side by the internal pillar of the inguinal opening—3d, spine of the pubis by the external pillar of the same opening—4th, about half an inch of the linea ilio-pectinea, forming Gimbernat's duplicature—5th, external border of the two anterior thirds of the crest of the ilium. *Use.* To depress the ribs, and rotate the trunk to the opposite side.

2d Layer.

2. *Obliquus Internus Ascendens.—Origin.* 1st, spinous processes of the two upper false vertebræ of the sacrum—2d, spinous processes of the three inferior lumbar vertebræ—3d, crest of the ilium—4th, outer or iliac half of Poupart's ligament. *Insertion.* 1st, inferior margin of the cartilages of the 2d, 3d, 4th, and 5th false ribs—2d, linea alba—3d, crest of the pubes. *Use.* To pull down the ribs, and bend the trunk to the same side.

3d Layer.

3. *Transversalis. Origin.* 1st, iliac half of Poupart's ligament—2d, the three anterior fourths of the internal border of the crest of the ilium—3d, the spinous and transverse processes of the four superior lumbar vertebræ—4th, inferior margin of the last rib—5th, inner surface of the cartilages of the seven inferior ribs. *Insertion.* 1st, crest of the pubes—2d, linea alba—3d, lateral margin of the ensiform appendix. *Use.* To support and compress the abdominal viscera

4. *Rectus.—Origin.*.Superior part of the pubic bone and symphysis pubis. *Insertion.* 1st, the 5th, 6th, and 7th ribs—2d, the costo-xiphoid ligament. *Use.* To bend the trunk forwards or to raise the pelvis, and to compress the lower part of the abdomen.

5. *Pyramidalis.—Origin.* Superior part of the os pubis. *Insertion.* Linea alba, about three inches above the pubes. *Use.* To assist the rectus muscle.

On the *anterior* part of the abdomen, the *flat* muscles become aponeurotic, and these aponeuroses are so disposed as to inclose, as in a sheath, the recti and pyramidales muscles—the aponeurosis of the *obliquus internus* at the outer margin of the rectus muscle, dividing into two *laminæ*—an anterior and a posterior: the first passing before the rectus united to the aponeurosis of the *external oblique* muscle, and the posterior lamina passing behind the rectus intimately connected with the anterior aponeurosis of the *transversus* muscle. At the *inferior third* of the abdomen, the anterior aponeuroses of all the three flat muscles pass anterior to the rectus, and *there*, consequently, the sheath does not exist.

Two of the flat muscles of the abdomen, the *obliquus internus*, and *transversalis*, are connected to the spine by *posterior aponeuroses*, the *first*, by means of a part of the *fascia lumborum*, and the *last*, by *three laminæ*—a *posterior*, implicated with the fascia lumborum, *a middle*, attached to the apices of transverse processes of lumbar vertebræ, and an *anterior*, attached to the roots of the same transverse processes.

The parts in *Hernia* fall naturally to be examined by the student, when dissecting the abdominal muscles. He should first examine the parts concerned in *Inguinal*, and then those of *Femoral* Hernia.

INGUINAL HERNIA.

Inguinal Hernia exists under two forms—*oblique* and *direct*. The first is that kind which passes along the *inguinal canal* before it appears at the *external inguinal opening;* and the second protrudes *directly* through the external inguinal opening, without passing along the inguinal canal.

In studying the parts in *oblique inguinal Hernia*, the student should turn his attention to the following points:—1. *The external inguinal opening*, situated near the pubes, and formed by the separation of the fibres of the aponeurosis of the external oblique muscle. 2. *The internal inguinal opening*, situated nearly midway between the anterior superior spine of the ilium and symphysis pubis, and consisting of an aperture in the *fascia transversalis;* and, 3d. *The canal*, or space situated between these two apertures—a fissure or canal extending obliquely from above downwards, and from without inwards, and bounded *above* by the lower margins of the *internal oblique* and *transversalis* muscles; *below*, by Poupart's ligament; *behind*, by the fascia transversalis, strengthened opposite the external inguinal opening, by the united tendons of the internal oblique and transversalis muscles; and *before* by the aponeurosis of the external oblique muscle. The student should still farther advert to the manner in which the external inguinal opening is closed up by the *intercolumnar fascia*, which connects the *pillars*, or margins of the opening, to each other, and to the cord, which passes through. The student should also attend to the *superficial fascia* covering still further all these parts, and strengthening the site of the opening, and extending along the spermatic cord.

The internal inguinal opening should still further be examined, in reference, 1st, to the *fascia infundibuliformis*, which connects the margins of the opening to the cord, and which is elongated by dragging the cord outwards; and, 2d, to the *epigastric artery*, which ascends upon the pubic side of the opening.

A piece of intestine, then, in passing along the inguinal canal, carries before it the following parts:—1st, the peritoneum; 2d, the fascia infundibuliformis, or fascia propria; 3d, the cremaster muscle; 4th, the intercolumnar fascia; 5th, the fascia superficialis; and, 6th, the skin.

Direct Inguinal Hernia passes straight from the abdomen, and through the external inguinal opening, without taking the course of the cord, protruding betwixt the epigastric artery, which bounds it on the iliac side and margin of the rectus muscle, which lies upon its pubic side, and carrying before it, 1st, the peritoneum; 2d, the fascia transversalis; 3d, the united tendons of the transversalis, and internal oblique muscles; 4th, the intercolumnar fascia; 5th, the fascia superficialis; and, 6th, the skin.

In this dissection, the student should note particularly the boundaries of the triangular space at the outer edge of this rectus muscle, through which this kind of Hernia protrudes, and the manner in which the fascia transversalis and tendons of the internal oblique and transverse muscles are strengthened by a set of accessory fibres, stretching obliquely from Poupart's ligament, and crest of pubes, to the linea alba.

FEMORAL HERNIA.

In femoral hernia, the intestine protrudes from under Poupart's ligament at the pubes, and forms a tumor on the thigh; and in dissecting the parts concerned in this kind of hernia, the student should, 1st, attend to Poupart's ligament—its osseous attachments, and the parts that pass under it; 2d, to the connection subsisting between Poupart's ligament and the fascia lata of the thigh, and, lastly, to the relationship which Poupart's ligament bears to the abdominal cavity.

Poupart's ligament, stretching from the anterior superior spine of the ilium to the spine of the pubes, transmits a process or insertion along the crest of the pubes, called *Gimbernat's ligament*, the crescentic margin of which is turned to the ilium. *Under Poupart's ligament* we find the following parts:—1st, the iliacus internus muscle—2d. the psoas magnus muscle—3d, the anterior crural nerve—4th, the femoral artery—5th, the femoral vein—and, 6th, the deep lymphatics of the thigh. These textures, connected by cellular membrane, form a considerable mass that tends to prevent the abdominal viscera from escaping under Poupart's ligament. The descent of the viscera is secured still further by the connection of the *fascia lata* to Poupart's ligament, and still more from the relationship Poupart's ligament bears to the *fascia iliaca*, and *fascia transversalis*. The student must endeavour to obtain a knowledge of these relationships by dissection, and for this purpose he should first remove the *skin* from the upper third of the anterior aspect of the thigh; next, the *fascia superficialis*, when he ought to make a careful dissection of the *fascia lata*, observing its division into *two layers superiorly*—an *iliac portion*, or *layer*, attached to Poupart's ligament, and situated upon the outer or iliac side of the thigh; and a *pectineal portion*, which descends from the spine and crest of the pubes, covering the pectineus muscle, and stretching *behind* the vessels of the thigh to the ligament of the hip joint. He ought particularly to note the manner in which the *iliac portion* stretches across, by *two horn-like* processes, to join the pectineal portion:- the *superior horn* stretching along the Poupart's ligament, and terminating at the spine of the pubes, and the *inferior horn*, stretching across about an inch and a half below Poupart's ligament—the two horns united forming *a crescentic margin*, the concavity of which is turned to the pubes. The student must further remark that this crescentic margin must be *made*, in some measure, with the knife; for it will be found at first connected by a *cribriform fascia* to Poupart's ligament, and the pectineal portion. This portion of the fascia lata is cellular, perforated by numerous openings for the transmission of vessels and nerves, must be removed, and the crescentic margin then exposed.

After the student has obtained a knowledge of the relations of the *fascia lata* to the pelvis, to Poupart's ligament, and to the vessels of the thigh, he should attend to the *inner surface* of the abdominal walls immediately above Poupart's ligament. The dissection should be made in the following way: An incision should be made from the umbilicus to the pubes, through the abdominal walls, and another from the umbilicus at right angles to the former, across to near the anterior spine of the ilium, and the flap turned down upon the thigh. The student should then peel off the peritoneum, and bring into view, 1st, the *fascia transversalis* lining the transverse and rectus muscles of the abdomen; and, 2d, the *fascia iliaca*, covering the iliac muscle. These *fasciæ* will be found to unite firmly behind Poupart's ligament, except at the pubic side, where the vessels are transmitted. *There* the fasciæ do not unite behind Poupart's ligament, but are seen passing respectively under it—the fascia transversalis *before*, and the fascia iliaca *behind*, the vessels, but turning towards each other, and uniting both on the pubic and iliac sides of the vessels, and thus forming a sheath, which can be traced surrounding the femoral vessels, nearly to the ham. Upon introducing the finger into this sheath, with its vessels, much obstruction is felt, except upon the *inner side* of the *femoral vein*, where some loose cellular membrane exists surrounding the lymphatic vessels that enter the pelvis from the thigh. If some force be used, the finger will be made to pass under Poupart's ligament, and clear the upper horn of the falciform process of the fascia lata, and still within the sheath. Immediately below Poupart's ligament, it must be remarked, that the side of the sheath presents a *perforated* appearance, from the superficial lymphatics piercing it at that point to join the deep-seated ones: this part of the sheath, then, is weaker than the other part, and readily yields to any distending cause, and assists in forming a pouch which contains the intestines. The canal thus formed by the introduction of the finger, or by the descent of a portion of intestine, is bounded on the *iliac side* by the femoral vein; on the *pubic side* by Gimbernat's ligament; *anteriorly* by Poupart's ligament, and a part of the fascia transversalsis, and *posteriorly* by the pubes, covered by a part of the fascia iliaca.

In the formation of a femoral hernia, the intestine carries before it in succession the following parts:—1st, a *peritoneal sac*— 2d, the *fascia propria*, formed by the cellular membrane of the canal and perforated part of the *sheath*—3d, the *cribriform fascia*—4th, the *fascia superficialis*—5th, the *skin*. The situation of the *epigastric artery*, and a peculiar variety of the *obturator artery* to the neck of the sac, should not be overlooked by the student. He will find the epigastric usually at the iliac side of the femoral opening, but he will not unfrequently find the obturator arising from the epigastric, and nearly encircling the aperture—a circumstance that should induce great caution in the use of the knife while relieving a strangulated hernia of this kind.

XII.—DIAPHRAGMATIC REGION.

Diaphragma.—*Origin.* 1st. Posterior surface of the xiphoid cartilage—2d. internal surface of the six inferior ribs—3d, transverse process of the first lumbar vertebra—4th, bodies of the four superior lumbar vertebræ. *Insertions.* The fibres run to a central *cordiform* tendon. *Use.* The principal muscle of respiration.

The diaphragm may be viewed as forming a vaulted partition between the thorax and abdomen, and presenting *two surfaces*, a thoracic or convex; and *an abdominal* or concave; and a *margin* which adheres to the base of the thorax, and is prolonged upon the bodies of the lumbar vertebræ nearly to the pelvis. Betwixt the crura of the diaphragm we find two *openings*—a superior or *œsophageal*, and an inferior or *aortic*, so denominated from the œsophagus and aorta, that respectively pass through them; and another opening, the *caval* in the cordiform tendon for transmitting the vena cava inferior to the heart.

XIII.—LUMBAR REGION.

1. *Psoas Parvus.—Origin.* 1st. Lateral part of the body of the last dorsal vertebra—2d, inferior adjoining fibro-cartilage. *Insertion.* Ilio-pectineal eminence of the os innominatum. *Use.* To bend the loins forwards.

2. *Psoas Magnus.—Origin.* 1st. Body of the last dorsal vertebra—2d, bodies and transverse processes of the four superior lumbar vertebræ—3d, intervening fibro-cartilages. *Insertion.* Trochanter minor of the thigh bone. *Use.* To carry the thigh forwards, and when the thigh is fixed to bring the body forwards.

3. *Iliacus Internus.—Origin.* Fossa iliaca. *Insertion.* In common with the psoas magnus into the trochanter minor. *Use.* Bends the thigh, and rolls it outwards.

4. *Quadratus Lumborum.—Origin.* 1st, the crest of the ilium posteriorly—2d, the ilio-lumbar ligament. *Insertion.* 1st, apices of the transverse processes of the four superior lumbar vertebræ—2d, the inferior margin of the twelfth rib. *Use.* To pull the trunk to the side, and depress the last rib.

XIV.—GENITAL REGION.

1st, *In the Male.*

1. *Cremaster.— Origin.* 1st, Inferior margin of the internal oblique muscle—2d, posterior surface of Poupart's ligament. *Insertion.* The fibres descend along the spermatic cord, to the tunica vaginalis of the testicle, some of them again ascending to the pubic bone. *Use.* To suspend, draw up, and compress the testicle.

2. *Erector Penis,—Origin.* Inner side of the tuber ischii. *Insertion* Fibrous envelope of the corpus cavernosum penis anterior to the root of the organ. *Use.* To pull down and compress the root of the penis.

3. *Ejaculator Seminis.—Origin.* 1st. Fibrous envelope of the corpus cavernosum penis anterior to the root — 2d. side of the bulb of the urethra. *Insertion.* 1st, its fellow on the mesial line of the bulb of the urethra—2d, confounded with the transversus perinei and sphincter ani muscles. *Use.* To compress the bulb, and assist in the discharge of the seminal fluid.

4. *Transversus Perinei.—Origin.* Internal side of the ramus and tuberosity of the ischium. *Insertion.* At the mesial line of the perineum it meets with its fellow, and is likewise confounded with the anterior extremity of the sphincter ani, and posterior extremity of the ejaculator seminis. *Use.* To steady the penis and oppose the protrusion of the rectum.

2d, *In the Female.*

1. *Erector Clitoridis.—Origin.* Inner side of the tuberosity of the ischium. *Insertion.* Fibrous covering of the clitoris. *Use.* To depress the clitoris and pull it backwards.

2. *Constrictor Vaginæ.—Origin.* Between the anus and vulva, where it is confounded with the sphincter ani and transversi perinei muscles. *Insertion.* Fibrous membrane of the clitoris. *Use.* To contract the tube which it surrounds.

3. *Transversus Perinei.*—The same as in the male, but smaller and often awanting.

The second, third, and fourth muscles in this region, are the *proper* muscles of the *Perineum:*—a space of great practical interest; *bounded before* by the scrotum; *behind* by the anus; and, on *each side* by the rami of the ischia and pubes. These muscles should be examined in relationship with the *fasciæ* of the perineum, with the *penis*, with the *anus*, and with the *pelvic viscera.* The student would do well to turn again to the inferior aperture of the *skeleton pelvis;* next to observe the *tubes* that issue from the *outlet*—as the urethra and anus in the male, and urethra, vagina, and anus in the female; 3d, to trace the course of the *superficial fascia* of the perineum from the cellular membrane of the abdomen and scrotum, over the muscles of the perineum, adhering to the rami of the pubes and ischia, as far back as the tuberosity, till it dips down and unites with the deep-seated fascia — to trace the *deep-seated fascia* which lies behind the muscles of the perineum and *exterior* to levator ani muscle, from the tuberosities of the ischia and from the rectum, along the rami of the ischia and pubes, as far as the triangular ligament of the pubes. The student will also observe, that where *this fascia* joins the *triangular ligament*, and assists in forming a canal for the urethra, *two processes* of it are detached, one forward, along the bulb of the penis, and another backwards, along the membranous part of the urethra, to the prostrate gland, vesiculæ seminales, inner surface of the pubes, and inner surface of the levator ani muscle.

XV.—ANAL REGION.

1. *Sphincter Ani.—Origin.* Point of the coccyx. *Insertion.* Middle of the perineum. *Use.* Contracts and closes the orifice of the rectum which it surrounds.

2. *Levator Ani.—Origin.* 1st, Posterior surface of the os pubis—2d, superior margin of the thyroid foramen—3d, that tendinous membrane that lines the obturator internus muscle —4th, spinous process of the ischium. *Insertion.* 1st, the

third and fourth bones of the coccyx—2d, its fellow behind and before the rectum—3d, sphincter ani—4th, posterior extremity of the ejaculator seminis muscle, and superior part of the constrictor vaginæ in the female. *Use.* To restrain the protrusion of the anus in evacuating the contents of the rectum, and to support the abdominal and pelvic viscera generally.

3. *Coccygeus.—Origin.* Spine of the ischium. *Insertion.* 1st, margin of the fifth sacral and first and second coccygeal bones. *Use.* To draw the coccyx forward, or prevent its displacement backwards.

XVI.—DORSAL REGION.

The muscles of the *Back* may be simply arranged into the *broad*, the *long*, and the *short*. The *broad*, lying most superficially and forming three layers. The *long* situated immediately under the broad muscles, and occupying the vertebral groove, and the *short* either connecting the head to the spine or situated between spinous and transverse processes of the vertebræ.

1st, *Superficial or broad Muscles.*

1st *Layer.*

1. *Trapezius.*—1st, spinous processes of all the dorsal vertebræ—2d, spinous process of the seventh cervical vertebra—3d, ligamentum nuchæ—4th, internal third of the superior curved line of the occipital bone. *Insertion.* 1st, posterior margin of the outer third of the clavicle—2d, internal margin of the acromion process of the scapula—3d, posterior margin of the spine of the scapula. *Use.* To carry the scapula and clavicle backwards, or to move it according to the three different directions of its fibres. To draw the head also backwards, and steady the dorsal portion of the spine.

2. *Latissimus Dorsi.—Origin.* 1st, posterior surface of the sacrum—2d, external margin of the posterior half of the ilium—3d, spinous processes of all the lumbar and six or seven inferior dorsal vertebræ—4th, extremities of the three or four last false ribs. *Insertion.* Anterior margin of the occipital groove of the humerus. *Use.* To carry the humerus downwards and backwards, and to roll it inwards; it also steadies the lower part of the spine.

2d *Layer.*

1 and 2. *Rhomboideus Major and Minor.—Origin.* 1st, inferior part of the ligamentum nuchæ—2d, spinous processes of the last cervical, and four or five superior dorsal vertebræ. *Insertion.* Base of the scapula between the spine and inferior angle. *Use.* To draw the scapula upwards and backwards.

3. *Serratus Posticus Inferior.—Origin.* Spinous processes of the three superior lumbar, and the three inferior dorsal verte-

bræ. *Insertion.* Inferior margins of the four last ribs. *Use.* To pull down the ribs to which it is attached, and thus act as an expiratory muscle.

3d Layer.

Serratus Posticus Superior.—Origin. 1st, inferior third of the ligamentum nuchæ—2d, spinous process of the seventh cervical, and first, second, and third dorsal vertebræ. *Insertion.* External surface, and superior margin of the second, third, fourth, and fifth ribs. *Use.* To raise those ribs, and expand the thorax.

2d, *Long Muscles,*

Some of which lie on the Dorso-cervical, and others on the Lumbo-dorsal regions of the Spine.

1. *Muscles on the Dorso-cervical Regions of the Spine.*

1*st Layer.*

1. *Splenius.—Origin.* Spinous processes of the five or six superior dorsal and last cervical vertebræ—2d, two inferior thirds of the ligamentum nuchæ. *Insertion.* 1st, Transverse processes of the first and second cervical vertebræ—2d, external surface of the mastoid process of the temporal bone and external half of the rough surface of the occipital bone, between its superior and inferior curved lines. *Use.* To carry the head backwards, and to the one side.

2. *Levator Scapulæ.—Origin.* Transverse processes of the four or five upper cervical vertebræ. *Insertion.* Superior angle and a small part of the base of the scapula. *Use.* To raise the scapula.

2d Layer.

1st, *Complexus.—Origin.* Transverse processes of the five superior dorsal and six inferior cervical vertebræ—2d, spinous process of the first dorsal vertebra. *Insertion.* Internal half of the rough surface between the superior and inferior curved lines of the occipital bone. *Use.* To pull the head back, and a little to the one side.

2d. *Trachelo-mastoideus.—Origin.* Transverse processes of the first vertebra of the back, and four inferior of the neck. *Insertion.* Posterior part of the external surface of the mastoid process of the temporal bone. *Use.* Carries the head back, and rolls it to the one side.

3d, *Transversalis Colli.—Origin.* 1st, transverse processes of the second, third, fourth, and fifth dorsal vertebræ—2d, sometimes from the longissimus dorsi. *Insertion.* The five inferior cervical vertebræ. *Use.* Carries the head backwards, and turns it to the one side.

4th, *Cervicalis Descendens.*—This is the *cervical portion* of the sacro-lumbalis muscle.

3d Layer.

1st, *Semi Spinalis Colli.*—*Origin.* Transverse processes of the six uppermost dorsal vertebræ. *Insertion.* Spinous processes of all the cervical vertebræ, except the first and last. *Use.* To draw the neck obliquely backwards, and to the one side.

4th Layer.

Part of Multifidus Spinæ.

2d, *Muscles on the Lumbo-dorsal region of the Spine.*

1*st Layer.*

1st, *Sacro-lumbalis.*—*Origin.* 1st, posterior surface of the sacrum—2d, crest of the ilium posteriorly—3d, apex of the spinous processes of all the lumbar vertebræ, which attachments are common to this muscle and the longissimus dorsi. *Insertion.* 1st, angle of the eleven inferior ribs—2d, shoulder of the first rib—3d, transverse processes of the four inferior cervical vertebræ, which portion of the muscle is usually described under the name *cervicalis descendens.* The musculi *accessorii ad sacro-lumbalem* are distinct portions which arise from eight or ten inferior ribs near their angles, and are lost in the sacro-lumbalis. *Use.* To pull the ribs down and assist in erecting the trunk.

2d, *Longissimus Dorsi.*—*Origin.* In common with the last muscle. *Insertion.* 1st, lower margin of eight or more inferior ribs—2d, transverse processes of the dorsal vertebræ. *Use.* To support the spine in the erect posture, and bend it backwards.

3. *Spinalis Dorsi.*—*Origin.* Spinous processes of the two superior lumbar, and two or three inferior dorsal vertebræ. *Insertion.* Spinous processes of the four dorsal vertebræ that follow the third. *Use.* To extend the vertebral column, and draw it backwards.

2d Layer.

Multifidus Spinæ.—*Origin.* 1st, posterior surface of the sacrum—2d, posterior extremity of the crest of the ilium—3d, transverse and articulating processes of all the lumbar and dorsal vertebræ—4th, transverse processes of the five inferior cervical vertebræ. *Insertion.* Spinous processes of all the lumbar, dorsal, and cervical vertebræ, except the atlas. *Use.* To support the spine, and to pull it backwards, and a little to the one side.

3d Short Muscles.

1. *Rectus Capitis Posticus Major.*—*Origin.* Spinous process of the second cervical vertebra. *Insertion.* Occipital bone, be-

tween the foramen magnum and inferior curved line. *Use.* T draw the head back, and to rotate it on its axis.

2. *Rectus Capitis Posticus Minor.—Origin.* Posterior arch o the atlas. *Insertion.* Small depression on the occipital bone, immediately behind the occipital foramen. *Use.* To draw the head back.

3. *Obliquus Inferior Capitis.—Origin.* Spinous process of the second cervical vertebra. *Insertion.* Transverse process of the atlas. *Use.* To rotate the atlas and head to the one side.

4. *Obliquus Superior Capitis.—Origin.* Transverse process of the first cervical vertebra. *Insertion.* The occipital bone behind the foramen magnum, and near the mastoid process of the temporal bone. *Use.* To draw the head backwards.

5. *Interspinales Colli, Dorsi, and Lumborum.*—Muscular fasciculi that connect the spinous processes of the contiguous true vertebræ. In the neck and loins they are well marked, and double. In the back they can be hardly said to exist. *Use.* to extend the spine.

6. *Intertransversales Colli, Dorsi, et Lumborum.*—Portions of muscle that stretch between the transverse processes of contiguous vertebræ. In the neck they are arranged into anterior and posterior, the first being six in number, and second five. The dorsal fasciculi are seldom well developed, and often awanting. The lumbar ones are five in number, and well developed. *Use.* To bend the spine to the side.

III. DIVISION.—MUSCLES OF THE EXTREMITIES.

The muscles of the superior extremity are invested with a dense fibrous membrane, or *fascia*, which binds them down, and supports them when in action. It varies in density in different parts of the limb, and receives names indicative of its situation upon the limb, as the *fascia* of the *upper arm*, *fore-arm*, &c. It may be traced from the spine of the scapula and infra-spinatus muscle, from the cellular membrane of the axilla, reinforced as it descends from the tendons of the pectoralis major, the latissimus dorsi, teres major, and deltoid muscles. In the shoulder and upper arm, the student should attend to the following points:—1st, the thin layer of it sent over the deltoid; 2d, the greater density of the part covering the infra spinatus, teres minor and major muscles, and muscles of upper arm; 3d, the dipping down of the fascia on each side to the external and internal margins of the humerus, and consequent formation by these septa of two fascial compartments, or bags, which do not communicate with each other, and in which the anterior and posterior muscles of the upper arm are inclosed; 4th, the greater density of the fascia near the elbow, and its further attachments to the condyles of the humerus and to the olecranon

In the *fore-arm*, the *fascia* is of great density, and very closely connected with the muscles, dipping down between them, and even forming sheaths for some of them. At the elbow, it descends from the tendon of the biceps anteriorly, and from that of the triceps behind, and from the condyles of the humerus, and intermuscular septa, on each side. It descends over the fore-arm to the wrist, and is there blended anteriorly with the anterior annular ligament, extending into the palm, and forming the palmar aponeurosis, and posteriorly forming the posterior annular ligament of the carpus, and attached also to the sulci on the inferior extremity of the radius, forming grooves for the transmission of the extensor tendons.

I.—Muscles of the Superior or Thoracic Extremity.

I.—SCAPULAR REGION.

1. *Deltoides.—Origin.* 1st, anterior margin of the scapulary third of the clavicle—2d, acromion process, and posterior margin of the spine of the scapula. *Insertion.* Deltoid impression or rough surface near the middle of the humerus. *Use.* To raise the humerus from the side of the trunk.

2. *Supra spinatus.—Origin.* Fossa supra-spinata of the scapula. *Insertion.* Superior muscular impression of the great tuberosity of the humerus. *Use.* To abduct and raise the humerus.

3. *Infra Spinatus.—Origin.* Nearly the whole of the infra spinal fossa of the scapula—2d, fascia of the shoulder. *Insertion.* Middle muscular impression of the great tuberosity of the humerus. *Use.* To abduct, raise, and carry backwards the humerus, and to roll it outwards.

4. *Teres Minor.—Origin.* Posterior surface of the scapula along its anterior margin. *Insertion.* The inferior depression on the great tuberosity of the humerus. *Use.* to draw the humerus downwards and backwards, and to roll it outwards.

5. *Teres Major.—Origin.* Anterior margin of the scapula, near the inferior angle of the bone. *Insertion.* Posterior margin of the occipital groove of the humerus. *Use.* To carry the humerus inwards and backwards, and to roll it inwards.

6. *Subscapularis—Origin.* Fossa subscapularis. *Insertion.* Little tuberosity of the humerus. *Use.* To draw the arm downwards, inwards, and to roll it upon its axis from without inwards.

II.—BRACHIAL REGION:

Anterior Muscles.

1. *Biceps.—Origin.* By two heads, the external or short head from the point of the coracoid process of the scapula, and the internal or long head from the superior part of the glenoid cavity of the same bone. *Insertion.* 1st, the fascia of the fore-arm—2d, the bicipital tuberosity of the radius. *Use.* To roll the radius outwards, to bend the elbow joint, and to carry the whole extremity forwards and inwards.

2. *Coraco-Brachialis—Origin.* In common with the short head of the biceps muscle. *Insertion.* Middle part of the internal surface of the humerus, between the brachialis anterior, and third portion of the triceps muscle. *Use.* To draw the arm forwards and inwards.

3. *Brachialis Anterior—Origin.* Anterior aspect of the humerus, from the insertion of the deltoid, to the inferior extremity of the bone. *Insertion.* Inferior rough surface of the coronoid process of the ulna. *Use.* To bend the elbow joint.

Posterior Muscle.

Triceps.—Origin. By three heads, the long or middle head, from the upper part of the anterior costa of the scapula—the second or external head, from the surgical neck of the humerus, below the insertion of the teres minor, and the third or internal head, from the shaft of the humerus, near the insertion of the teres major. *Insertion.* Superior surface of the olecranon. *Use.* To extend the fore-arm, and draw the upper extremity backwards.

III.—RADIO-CUBITAL REGION.

Or Region of the Fore-arm.

1st, *External Muscles.*

1. *Supinator Longus.*—1st, inferior third of the external margin of the humerus—2d, intermuscular membrane. *Insertion.* Anterior margin of the lower extremity of the radius, near the base of the styloid process. *Use.* Brings the hand mid-way between pronation and supination, and bends the elbow joint.

2. *Extensor Carpi Radialis Longior.—Origin.* The inferior part of the external margin, and upper part of the external condyle of the humerus. *Insertion.* Posterior part of the upper extremity of the metacarpal bone of the fore finger. *Use.* To carry the hand backwards upon the fore-arm, and to extend the fore-arm.

3. *Extensor Carpi Radialis Brevior.—Origin.* External condyle of the humerus. *Insertion.* Posterior part of the superior extremity of the metacarpal bone supporting the middle finger. *Use.* Nearly the same as former muscle.

2d Posterior Muscles.

1st Layer.

1. *Extensor Communis Digitorum.—Origin.* 1st, external condyle of the humerus—2d, fascia of the fore-arm, and membranous septa between this and adjoining muscles. *Insertion.* Posterior surface of the four smaller fingers by distinct tendons—more particularly the second and third phalanges of these fingers. *Use.* To extend the fingers to which they are attached, and to carry the hand backwards towards the fore-arm.

2. *Extensor Proprius Minimi Digiti.—Origin.* 1st, the external condyle of the humerus—2d, membranous septa between this and surrounding muscles. *Insertion.* Posterior surface of the second and third phalanges of the little finger. *Use.* To extend the little finger.

3. *Extensor Carpi Ulnaris.—Origin.* 1st, external condyle of the humerus—2d, inter-muscular septa—3d, middle third of the posterior margin of the ulna. *Insertion.* Posterior part of the superior extremity of the metacarpal bone of the little finger. *Use.* To carry the hand towards the posterior surface of the fore-arm, and incline it to the ulna.

4. *Anconeus.—Origin.* The external condyle of the humerus. *Insertion.* Superior fifth of the posterior surface of the ulna. *Use.* To extend the fore-arm.

2d Layer.

1st, *Supinator Brevis.—Origin.* External condyle of the humerus, and neighbouring part of the posterior surface of the ulna. *Insertion.* Superior third of the external surface of the radius. *Use.* To roll the radius outwards, and thus to produce supination of the hand.

2. *Extensor Primus Pollicis.—Origin.*—1st, posterior surface of the ulna, immediately below the anconeus—2d, posterior surface of the interosseous ligament—3d, posterior surface of the radius. *Insertion.* Radial side of the superior extremity of the metacarpal bone of the thumb. *Use.* To draw the metacarpal bone of the thumb outwards and backwards.

3. *Extensor Secundus Pollicis.—Origin.* 1st, a small part of the posterior surface of the ulna near the former muscle—2d, posterior surface of the interosseous ligament. *Insertion.* Posterior surface of the superior extremity of the first phalanx of the thumb. *Use.* To extend the first phalanx of the thumb.

4. *Extensor Tertius Pollicis—Origin.* 1st, the middle of the posterior surface of the ulna—2d, posterior surface of the interosseous ligament. *Insertion.* The last phalanx of the thumb. *Use.* To extend the thumb.

5. *Extensor Indicis.—Origin.* Posterior surface of the ulna and interosseous ligament. *Insertion.* Posterior part of the second and third phalanges of the fore finger. *Use.* To extend the fore finger.

3d *Anterior Muscles.*

1*st Layer.*

1. *Pronator Teres.—Origin.* 1st, the internal condyle of the humerus—2d, coronoid process of the ulna. *Insertion.* Middle part of the external surface of the radius. *Use.* To roll the radius outwards, and thus to turn the hand prone.

2. *Flexor Carpi Radialis.—Origin.* Internal condyle of the humerus. *Insertion.* Anterior part of the superior extremity of the metacarpal bone of the fore finger. *Use.* To bring the palm of the hand in the direction of the anterior surface of the fore-arm.

3. *Palmaris Longus.— Origin.* Internal condyle of the humerus. *Insertion.* 1st, anterior surface of the anterior annular ligament of the carpus — 2d, superior extremity of the palmar aponeurosis. *Use.* Stretches the palmar aponeurosis, and moves the hand towards the anterior surface of the fore-arm.

4. *Flexor Carpi Ulnaris.—Origin.* 1st, the internal condyle of the humerus—2d, internal surface of the olecranon—3d, posterior margin of the ulna. *Insertion.* The os pisiforme. *Use.* To bring the palm of the hand towards the anterior surface of the fore-arm.

2*d Layer.*

Flexor Sublimis.—Origin. 1st, internal condyle of the humerus—2d, coronoid process of the ulna—3d, internal lateral ligament of the elbow joint—4th, superior part of the anterior border of the radius below the bicipital tuberosity. *Insertion.* By four tendons into the second phalanges of the four smaller fingers. *Use.* To bend the four smaller fingers.

3*d Layer.*

1. *Flexor Longus Pollicis.— Origin.* The three superior fourths of the anterior surface of the radius. *Insertion.* Anterior surface of the last phalanx of the thumb. *Use.* To bend the thumb.

2. *Flexor Profundus.—Origin.* 1st, the three superior fourths of the anterior and internal surfaces of the ulna—2d, neigh-

bouring part of the interosseous ligament. *Insertion.* Anterior surface of the last phalanx of the four smaller fingers. *Use.* To bend the fingers.

4th Layer.

Pronator Quadratus.—Origin. The inferior fourth of the anterior surface of the ulna. *Insertion.* Inferior fourth of the anterior surface of the radius. *Use.* To roll the radius so as to produce pronation of the hand.

In dissecting the *anterior* muscles of the *fore-arm*, the student will observe that the *second* layer lies throughout the greater part of its extent quite superficially ; he should also note particularly the manner in which the tendons of the *deep flexor* of the fingers perforate the corresponding tendons of the *superficial flexor*, and how the tendons of both muscles are strapped down to the bones of the fingers by dense fibrous membranes.

IV.—CARPO-METACARPO-DIGITAL REGION,

Or Region of the Hand.

The muscles on the *palmar* aspect of the hand are covered by the *palmar aponeurosis*, a fibrous membrane, extending from the fascia of the fore-arm and palmaris longus muscle, and consisting of *three* subdivisions: one covering the muscles of the thumb: another those of the little finger: and a denser triangular portion, which stretches to the inferior extremities of the four small metacarpal bones to which it is attached. The student should remark its loose connection to the deeper parts of the hand, and its attchment to the metacarpal bones, so as to leave spaces for the descent of the blood-vessels and nerves to the fingers.

1st. *Muscles of the Ball of the Thumb.*

1. *Abductor Pollicis.—Origin.* 1st, anterior surface of the annular ligament of the carpus—2d, anterior surface of the os scaphoides. *Insertion.* Radial side of the superior extremity of the first bone of the thumb. *Use.* To draw the thumb from the other fingers.

2. *Opponens pollicis.—Origin.* Anterior surface of the annular ligament—2d, anterior surface of the os trapezium. *Insertion.* Anterior surface and external border of the metacarpal bone of the thumb. *Use.* To carry the metacarpal bone of the thumb in the direction of the little finger.

3. *Flexor Brevis Pollicis.—Origin.* By two portions—1st, the anterior, from the anterior surface of the annular ligament—2d, the posterior from the os magnum, and anterior part of the superior extremity of the third metacarpal bone. *Insertion.* Anterior surface of the upper extremity of the first bone of the

thumb. *Use.* To bend the first phalanx upon the metacarpal bone of the thumb.

4. *Adductor Pollicis.—Origin.* The three inferior fourths of the anterior surface of the third metacarpal bone. *Insertion.* Ulnar side of the superior extremity of the first bone of the thumb. *Use.* Draws the thumb towards the other fingers.

2d, Muscles of the Ball of the Little Finger.

1. *Palmaris Brevis.—Origin.* Anterior surface of the annular ligament, and ulnar margin of the palmar aponeurosis. *Insertion.* The skin of the upper part of the ulnar edge of the hand. *Use.* To wrinkle the skin covering the ulnar margin of the hand.

2. *Abductor Minimi Digiti.—Origin.* Os pisiforme. *Insertion.* The ulnar side of the upper extremity of the first phalanx of the little finger. *Use.* To carry the little finger from the other fingers.

3. *Flexor Brevis Minimi Digiti.—Origin.* 1st, anterior surface of the annular ligament—2d, process of the os unciforme. *Insertion.* Ulnar side of the superior extremity of the first phalanx of the little finger. *Use.* To bend and draw the little finger from the other fingers.

4. *Adductor Ossis Metacarpi Minimi Digiti.—Origin,* 1st, anterior surface of the annular ligament—2d, process of the os unciforme. *Insertion.* Anterior surface and ulnar margin of the fifth metacarpal bone. *Use.* To carry the fifth metacarpal bone forwards, and towards the other metacarpal bones.

3d, Muscles in the middle of the Palm.

1st Layer.

Lumbricales (quatuor.)—Origin. The first from that tendon of the flexor profundus which goes to the fore finger; the second, third and fourth, from the separation of the tendons of the same muscle which go to the other fingers. *Insertion.* Tendons of the extensor communis digitorum, at the upper extremity of the first phalanges of the four smaller fingers. *Use.* To bend the first phalanges of the four smaller fingers upon the corresponding metacarpal bones, and to abduct or adduct the fingers.

2d Layer, or Palmar Interossei.

1. *Prior Indicis.—Origin.* Radial side of the anterior surface of the second metacarpal bone. *Insertion.* Radial side of the superior extremity of the first bone of the fore finger. *Use.* To carry the fore finger towards the thumb.

2. *Posterior Indicis.—Origin.* Ulnar side of the anterior surface of the second metacarpal bone. *Insertion.* Ulnar side of

the superior extremity of the first bone of the fore finger. *Use.* To carry the fore finger towards the mid finger.

3. *Prior Annularis.—Origin.* Radial side of the anterior surface of the fourth metacarpal bone. *Insertion.* Radial side of the upper extremity of the first bone of the ring finger. *Use.* To carry the ring finger to the mid finger.

4. *Interosseus Auricularis.*—Radial side of the anterior surface of the fifth metacarpal bone. *Insertion.* Radial side of the head of the first bone of the little finger. *Use.* To carry the little finger towards the other finger.

3d Layer, or Dorsal Interossei.

1. *Abductor Indicis, or Semi-interosseus.—Origin.* Superior half of the ulnar surface of the first metacarpal bone. *Insertion.* In common with the prior indicis. *Use.* Assists the prior indicis, and draws the thumb towards the fore finger.

2. *Prior Medii.—Origin.* 1st, ulnar surface of the second and radial surface of the third metacarpal bones. *Insertion.* Radial side of the superior extremity of the metacarpal bone of the mid finger. *Use.* To draw the mid finger towards the thumb.

3. *Posterior Medii.—Origin.* Ulnar side of the third, and radial side of the fourth metacarpal bones. *Insertion.* Ulnar side of the upper extremity of the mid finger. *Use.* To carry the mid finger towards the ring finger.

4. *Posterior Annularis.—Origin.* Ulnar surface of the fourth, and radial surface of the fifth metacarpal bones. *Insertion.* Ulnar side of the upper extremity of the first bones of the ring finger. *Use.* To pull the ring finger towards the little finger.

III. DIVISION.—MUSCLES OF THE EXTREMITIES.

II.—Muscles of the Inferior or Pelvic Extremity.

The muscles of the inferior extremity are invested like the superior with a dense fibrous layer or fascia, the *fascia lata*, which ought to be carefully dissected by the student, and its relationships noted. He should particularly observe—1st, Its mode of attachment, both to the superior and inferior margin of the pelvis—2d, Its descent upon the thigh closely investing the muscles, and sending downwards numerous septa and investments for the muscles—3d, Its greater density upon the external than internal part of the thigh—4th, Its attachments to the linea aspera in such a manner as form an anterior and a posterior great compartment or bag, not communicating with each other—5th, Its inferior attachments to the patella, to the condyles, and its continuation into the fascia of the leg.

I.—GLUTEAL REGION,

Or Region of the Haunch.

1st Layer.

Gluteus Maximus.—Origin. 1st, dorsum of the ilium between the crest and superior curved line—2d, posterior surface of the sacrum—3d, lateral margin of the coccyx—4th, external surface of the great sacro-sciatic ligament. *Insertion.* 1st, fascia lata—2d, external branch of the superior bifurcation of the linea aspera. *Use.* To extend the thigh, to abduct and roll it outwards, and to maintain the body in the erect posture.

2d Layer.

1. *Gluteus Medius.—Origin.* That part of the dorsum ilii betwixt the superior and inferior curved lines. *Insertion.* Superior margin of the trochanter major. *Use.* Besides producing the same effects as the former muscle, it carries the thigh forwards and rotates it inwards.

2. *Pyriformis.—Origin.* 1st, lateral part of the anterior surface of the sacrum—2d, anterior surface of the great sacro-sciatic ligament—3d, posterior extremity of the ilium. *Insertion.* Digital cavity of the trochanter major. *Use.* To roll the thigh outwards.

3. *Geminus Superior.—Origin.* External surface of the spinous process of the ischium. *Insertion.* Digital cavity of the great trochanter. *Use.* To roll the thigh outwards.

4. *Obturator Internus.—Origin.* 1st, the posterior surface of the os pubis immediately anterior to the obturator foramen—2d, internal surface of the obturator ligament. *Insertion.* Digital cavity of the trochanter major. *Use.* The same as last muscle.

5. *Geminus Inferior.—Origin.* The superior posterior part of the tuberosity of the ischium. *Insertion.* Digital cavity of the trochanter major. *Use.* Same as the geminus superior.

6. *Quadratus Femoris.—Origin.* External surface of the tuberosity of the ischium. *Insertion.* Posterior inter-trochanteral line. *Use.* To roll the thigh outwards.

3d Layer.

Gluteus Minimus.—Origin. Dorsum of the ilium below the inferior curved line. *Insertion.* Anterior part of the trochanter major. *Use.* Same as gluteus medius.

II.—FEMORAL REGION.

1st. *Anterior Muscles.*

1. *Sartorius.—Origin.* 1st, anterior superior spinous process of the ilium—2d, upper half of the notch between the two anterior superior spinous processes of the ilium. *Insertion.* Superior part of the internal surface of the tibia near the anterior tuberosity. *Use.* To bend the knee, and carry the leg at the same time inward and forwards.

2. *Rectus.—Origin.* 1st, anterior inferior spinous process of the ilium—2d, dorsum of the ilium immediately above the acetabulum cavity. *Insertion.* 1st, superior margin of the patella in conjunction with the two vasti and crureus muscles—2d, anterior tuberosity of the tibia through the ligament of the patella. *Use.* Extends the leg and bends the thigh upon the pelvis.

8. *Crureus.—Origin.* 1st, anterior inter-trochanteral line—2d, anterior and external surfaces of the femur. *Insertion.* Superior margin of the patella in connection with the rectus and the vasti muscles. *Use.* To extend the leg.

2d, *External Muscles.*

1. *Tensor Vaginæ Femoris.—Origin.* External side of the anterior superior spinous process of the ilium. *Insertion.* Between the two layers of the fascia lata of the thigh, about two inches below the trochanter major. *Use.* To stretch the fascia lata, to abduct the thigh and roll it inwards.

2. *Vastus Externus.—Origin.* 1st, the lower margin of the trochanter major—2d, the whole length of the external margin of the linea aspera. *Insertion.* 1st, the external margin of the tendon of the rectus muscle—2d, the crureus—3d, the base and external margin of the patella—4th, the external tuberosity of the tibia. *Use.* To extend the leg.

3d, *Internal Muscles.*

1st *Layer.*

1. *Vastus Internus.—Origin.* 1st, the root of the trochanter minor—2d, the internal margin of the linea aspera. *Insertion.* 1st, the internal margin of the tendon of the rectus muscle—2d, the crureus—3d, the base and internal margin of the patella—4th, the internal tuberosity of the tibia. *Use.* To extend the leg.

2. *Pectineus.—Origin.* The superior margin of the os pubis between the ilio-pectineal eminence and pubic spine. *Insertion.* The internal branch of the superior bifurcation of the

linea aspera. *Use.* To bend, adduct, and rotate the thigh outwards.

3. *Abductor Longus.—Origin.* The anterior surface of the os pubis and symphysis pubis. *Insertion.* The middle third of the linea aspera. *Use.* To adduct, bend, and rotate the thigh outwards.

4. *Gracilis.—Origin.* 1st, anterior surface of the body of the pubis near the symphysis—2d, anterior margin of the descending ramus of the pubis. *Insertion.* Superior part of the internal surface of the tibia near its anterior tuberosity. *Use.* Adducts the lower limb, and bends the leg upon the thigh.

2d Layer.

Adductor Brevis.—Origin. Anterior surface of the body of the pubis below the origin of the adductor longus. *Insertion.* Superior third of the linea aspera. *Use.* To adduct, bend, and roll the thigh outwards.

3d Layer.

1. *Adductor Magnus.—Origin.* 1st, the anterior surface of the ramus of the pubis—2d, the anterior surface of the ramus of the ischium—3d, external surface of the tuberosity of the ischium. *Insertion.* 1st, the external branch of the superior bifurcation of the linea aspera—2d, linea aspera proper—3d, internal tuberosity of the femur. *Use.* To adduct, bend, extend, and rotate the thigh outwards.

2. *Obturator Externus.—Origin.* 1st, the body of the pubis—2d, ramus of the pubis and ischium—3d, external surface of the obturator ligament. *Insertion.* Digital cavity of the trochanter major. *Use.* To roll the thigh outwards.

4th, *Posterior Muscles.*

1. *Semitendinosus.—Origin.* Posterior part of the tuberosity of the ischium, and for three inches intimately connected with the biceps. *Insertion.* Inner surface of the tibia, near the patellar tuberosity. *Use.* To bend the knee, extend the thigh, and rotate the leg inwards.

2. *Biceps.—Origin.* 1st, posterior and external part of the tuberosity of the ischium, and for three inches intimately connected with the former muscle—2d, external margin of the linea aspera—these two attachments constitute respectively the long and short heads of this muscle. *Insertion.* Head of the fibula. *Use.* To bend the knee, and extend the thigh.

3. *Semimembranosus.—Origin.* Tuberosity of the ischium anterior to the attachment of the two preceding muscles. *Insertion.* Posterior part of the internal tuberosity of the tibia. *Use.* To bend the knee, and extend the thigh.

III.—TIBIO-PERONEAL REGION,

Or *Region of the* LEG.

The *fascia* of the *Leg* should be carefully dissected before the muscles of this region are exposed.—This fascia covers the muscles of the leg, and extends to the foot. It consists of three portions, an anterior, a fibular, and a posterior, corresponding with the three divisions of the muscles in this region. The anterior and fibular divisions are peculiarly strong.—The posterior consists of two layers, a superficial and deep-seated, rarely so strongly marked as the anterior. The student should also note the formations of the annular ligaments at the ankle by this fascia, and its continuation downwards, both to the dorsal and plantar aspects of the foot as far as the toes.

1*st*, *Anterior Muscles.*

1st, *Tibialis Anticus.—Origin.* 1st, superior half of the internal surface of the tibia—2d, anterior surface of the interosseous ligament. *Insertion.* 1st, base of the internal cuneiform bone—2d, internal side of the posterior extremity of the first metatarsal bone. *Use.* To bend and turn the foot inwards.

2 *Extensor Longus Pollicis Pedis.—Origin.*—The middle third of the tibial surface of the fibula, anteriorly—2d, neighbouring part of the anterior surface of the interosseous ligament. *Insertion.* Superior surface of the last phalanx of the great toe. *Use.* Extends the great toe and bends the ankle joint.

3. *Extensor Communis Digitorum Pedis.—Origin.* 1st, external tuberosity of the tibia—2d, two superior thirds of the anterior part of the tibial surface of the fibula. *Insertion.* Superior surface of the second and third phalanges of the four smaller toes. *Use.* Extends the four smaller toes and bends the ankle joint.

4. *Peroneus Tertius.—Origin.* The inferior third of the external margin, and part of the adjoining tibial surface of the fibula. *Insertion.* Superior surface of the posterior extremity of the metatarsal bone of the little toe. *Use.* To bend the ankle joint and abduct the foot.

2d, *External Muscles.*

1. *Peroneus Longus.—Origin.* 1st, the external part of the head of the fibula—2d, superior third of its external surface—3d, membranous septa which separate this muscle from the anterior and posterior muscles of this region. *Insertion.* After crossing the sole of the foot, it is attached to the posterior extremity of the metatarsal bone of the great toe. *Use.* To extend the foot, to raise its external margin, and to turn the toes outwards.

2. *Peroneus Brevis.—Origin.* The two inferior thirds of the external surface of the fibula. *Insertion.* Superior part of the posterior extremity of the metatarsal bone of the little toe. *Use.* Assists the peroneus longus.

3d, *Posterior Muscles.*

1st, *Superficial Muscles, or Muscles of the Calf of the Leg, (which lie over each other in the following order.)*

1. *Gastrocnemius.—Origin.* By two heads—1st, the external head, from the posterior part of the external condyle of the femur, above the articulating surface—2d, the internal head, from the corresponding part of the internal condyle. *Insertion.* Posterior extremity of the os calcis. *Use.* To extend the foot and bend the knee joint.

2. *Plantaris.—Origin.* Posterior part of the external condyle of the femur. *Insertion.* 1st, inner side of the tendo Achillis—2d, superior part of the os calcis. *Use.* Assists the former muscle.

3. *Soleus.—Origin.* 1st, posterior surface of the head of the fibula—2d, superior third of the posterior surface of the same bone—3d, oblique line on the posterior surface of the tibia—4th, about three inches of the internal border of the tibia, below the oblique line. *Insertion.* Posterior extremity of the os calcis. *Use.* To extend the foot.

The dissection of these muscles will lead the student to observe the *strong tendon* (Tendo Achillis), by which they are attached to the os calcis, and to note its *form* and its relation to the *skin*—to the *deep-seated fascia*, and to the os calcis.

2d, *Deep-seated Muscles, (forming one layer.)*

1. *Popliteus.—Origin.* The depression on the tuberosity of the external condyle of the femur. *Insertion.* Posterior surface of the tibia above the oblique line. *Use.* To bend the knee, and when bent to rotate the leg inwards.

2. *Flexor Longus Pollicis Pedis.*—1st, two inferior thirds of the posterior surface of the fibula—2d, lower part of the posterior surface of the interosseous ligament. *Insertion.* Posterior part of the inferior surface of the last phalanx of the great toe. *Use.* To bend the great toe, and extend the ankle-joint.

3. *Flexor Communis Digitorum Longus.—Origin.* The two middle thirds of the posterior surface of the tibia. *Insertion.* By four tendons, into the last phalanges of the four smaller toes. *Use.* To bend the four smaller toes, and extend the foot.

4. *Tibialis Posticus.—Origin.* 1st, internal surface of the fibula, behind the interosseous ligament—2d. corresponding part of that ligament—3d, the three superior fourths of the pos-

terior surface of the tibia. *Insertion.* Tuberosity of the scaphoid, and inferior surface of the internal cuneiform bone. *Use.* To extend the ankle-joint and turn the foot inwards.

IV.—TARSO METATARSO-DIGITAL REGION,

Or region of the FOOT.

1st, *Muscle of the Dorsal Region of the Foot.*

Extensor Brevis Digitorum Pedis.—Origin. 1st, External surface of the os calcis anteriorly—2d, external astragalo-calcaneal ligament—3d, annular ligament of the tarsus. *Insertion.* By four tendons, into the superior part of the posterior extremity of the first phalanx of the great toe, and the second and third phalanges of the three succeeding toes. *Use.* To extend the toes to which these tendons are attached.

The muscles situated on the *plantar aspect* of the foot are supported and protected by a dense fibrous layer, the *plantar aponeurosis* which stretches from the posterior extremity of the os calcis, to the anterior extremities of the five metatarsal bones. In dissecting this part, the student should observe its relationship to the skin and to the muscles which it covers: its three-fold division, corresponding with the arrangement of the muscles: its triangular form—and its mode of attachment to the metatarsal bones, leaving interstices for the transit of the blood vessels and nerves.

2d, *Muscles on the Tibial Side of the Sole of the Foot.*

1. *Abductor Pollicis Pedis.—Origin.* 1st, internal tuberosity on the inferior surface of the os calcis—2d, internal annular ligament of the tarsus. *Insertion.* Tibial side of the posterior extremity of the first bone of the great toe. *Use.* Carries the great toe away from the other toes, and bends its slightly.

2. *Flexor Brevis Pollicis Pedis.—Origin.* 1st, anterior inferior part of the os calcis—2d, inferior part of the first and second cuneiform bones. *Insertion.* Ossa sesamoidea, and inferior surface of the posterior extremity of the first bone of the great toe. *Use.* To bend the first phalanx of the great toe upon the first metatarsal bone.

3d, *Abductor Pollicis Pedis.—Origin.* 1st, inferior surface of the os cuboides—2d, fibrous membrane that binds down the tendon of the peroneus longus—3d, posterior extremities of the third and fourth metatarsal bones. *Insertion.* Fibular side of the posterior extremity of the first bone of the great toe, and external adjoining sesamoid bone. *Use.* To draw the great toe to the other toes, and bend it a little.

3d, *Muscles on the Fibular Side of the Sole of the Foot.*

1. *Abductor Minimi Digiti Pedis.—Origin.* External tuberosity on the inferior surface of the os calcis. *Insertion.* 1st, tuberosity of the fifth metatarsal bone—2d, fibular side of the posterior extremity of the first phalanx of the little toe. *Use.* To draw the little toe from the other toes.

2d, *Flexor Brevis Minimi Digiti Pedis.—Origin.* 1st, inferior part of the posterior surface of the fifth metatarsal bone—2d, fibrous sheath of the tendon of the peroneus longus muscle. *Insertion.* Inferior and fibular surfaces of the posterior extremity of the first bone of the little toe. *Use.* To bend the first phalanx of the little toe upon the fifth metatarsal bone.

4th, *Muscles in the Middle of the Sole of the Foot.*

1st *Layer.*

Flexor Brevis Digitorum Pedis.—Origin. Inferior surface of the os calcis between the two tuberosities. *Insertion.* By four small tendons into the second phalanges of the four smaller toes. In each tendon an opening exists for the transmission of the tendons of the long flexor. *Use.* To bend the second phalanges of the four smaller toes upon the first, and these upon the corresponding metatarsal bones.

2d *Layer.*

1. *Flexor Accessorius.—Origin.* Sinuosity of the os calcis. *Insertion.* Superior surface and external margin of the tendon of the flexor longus digitorum muscle. *Use.* To assist the long flexor, and to correct the obliquity of that muscle's pull.

2d, *Lumbricales Pedis, Quatuor.—Origin.* The tendons of the flexor longus digitorum pedis. *Insertion.* 1st, internal and posterior surfaces of the first phalanges of the four smaller toes—2d, extensor tendons of the four smaller toes. *Use.* To bend the first phalanges of the four smaller toes upon the corresponding metatarsal bones.

3d *Layer.*

Transversalis Pedis.—Origin. Inferior surface of the four last metatarso-digital ligaments. *Insertion.* Fibular side of the anterior extremity of the metatarsal bone of the great toe. *Use.* To approximate the outer and inner margins of the foot, and thus to render the sole of the foot more concave.

4th *Layer, or Plantar Interosseous Muscles.*

1. *Interosseus Plantaris Primus—Origin.* Tibial side of the inferior surface of the third metatarsal bone. *Insertion.* Tibial side of the posterior extremity of the first phalanx of the middle toe. *Use.* Draws the middle toe towards the great toe.

2d, *Interosseus Plantaris Secundus.—Origin.* Tibial side of the inferior surface of the fourth metatarsal bone. *Insertion.* Tibial side of the posterior extremity of the first bone of the fourth toe. *Use.* Pulls the fourth toe towards the great toe.

3. *Interosseus Plantaris Tertius.—Origin.* Tibial side of the inferior surface of the fifth metatarsal bone. *Insertion.* Tibial side of the posterior extremity of the first bone of the little toe. *Use.* To carry the little toe towards the other toes.

5th *Layer, or Dorsal Interosseous Muscles.*

1. *Interosseus Dorsalis Primus.—Origin.* 1st, Tibial surface of the second metatarsal bone—2d, a small part of the fibular surface of the first. *Insertion.* Tibial side of the posterior extremity of the first bone of the second toe. *Use.* To draw the second toe from the middle toe.

2. *Interosseus Dorsalis Secundus.—Origin.* 1st, Fibular surface of the second metatarsal bone—2d, a small part posteriorly of the tibial surface of the third. *Insertion.* Fibular side of the posterior extremity of the first phalanx of the second toe. *Use.* To carry the second toe towards the middle toe.

3d, *Interosseus Dorsalis Tertius.—Origin.* 1st, Fibular surface of the third metatarsal bone—2d, posterior part of the tibial surface of the fourth. *Insertion.* Fibular side of the posterior extremity of the first phalanx of the middle toe. *Use.* To draw the middle toe towards the little toe.

4th, *Interosseus Dorsalis Quartus.—Origin.* 1st, Fibular surface of the fourth metatarsal bone—2d, posterior part of the tibial surface of the fifth. *Insertion.* Fibular side of the posterior extremity of the first phalanx of the fourth toe. *Use.* To carry the fourth toe towards the little toe.

The following is an *arrangement*, according to which *all* the muscles may be dissected upon *one subject:*—

Regions.	Where Muscles to be found.
1. Superficial Cervical,	Page 57
2. Inferior Hyoideal,	58
3. Superior Hyoideal,	59
4. Epicranial.	52
5 Auricular (external),	55
6. Palpebral,	52
7. Superciliary,	52
8. Ocular,	53
9. Superior Labial,	53
10. Nasal,	53
11. Inferior Labial,	54
12. Buccal,	54
13. Oral,	55
14. Zygomatic (superficial layer),	56

15. Temporal,	56
16. Pharyngeal,	60
17. Zygomatic (deep-seated),	56
18. Palatine,	56
19. Lingual,	57
20. Auricular (internal),	55
21. Laryngeal,	59
22. Dorsal,	71
23. Anterior Thoracic,	62
24. Lateral Thoracic,	62
25. Abdominal,	63
26. Diaphragmatic,	68
27. Anterior Cervico-Vertebral,	61
28. Lateral do. do.	61
29. Lumbar,	69
30. Intercostal,	62
31. Genital,	69
32. Anal,	70
33. Scapular,	22
34. Brachial,	76
35. Radio-ulnar,	76
36. Carpo-Metacarpo-Digital,	79
37. Gluteal,	82
38. Femoral,	83
39. Tibio-Peroneal,	85
40. Tarso-Metatarso-Digital,	87

PART III.

NERVOUS SYSTEM.

The nervous system in man is extremely complicated. It may be viewed, however, as consisting of the following subordinate parts:—1st, *The cerebro-spinal axis;* 2d, *cerebral* and *spinal nerves;* and, 3d, *the ganglionic system*, usually denominated the *great sympathetic nerve.*

The cerebro-spinal axis, or great central division of the nervous system, for the sake of simplicity and reference, is farther subdivided into the *encephalon* or *brain*, and into the *spinal marrow*, or *spinal cord.*

The *nerves* of the cerebro-spinal axis, are of two kinds—1st, nerves of sensation; 2d, nerves of motion.

And the *Ganglionic system*, of nervous matter consist, 1st, of *ganglia*, or nervous knots, or centres; and, 2d, of *nerves*, that radiate from *these* centres.

The nervous matter, or *neurine*, as it is now frequently called, presents itself under two forms, 1st, the grey: and, 2dly, the white nervous matter, which differ from each other, in consistency as well as colour. The *grey* is soft and of a pulpy appearance, and the *white* of a well-marked fibrous structure. The microscopic observations of Ehrenberg, however, show that the grey matter is fibrous as well as the white—that in the grey matter the fibres are knotted like a string of beads, the bead like swellings being at some distance from each other—and the fibres farther interspersed with *globules* and *plates* of a peculiar kind. In the white matter the articulated or knotted fibres are interspersed with other fibres regularly cylindrical and straight, and that the cylindrical fibres are about $\frac{1}{120}$ of a line in diameter; the cylindrical fibres are also tubular and seem to contain a granular nervous matter, but the knotted fibres appear to be of a different structure.

The olfactory optic and auditory nerves are composed according to the same authority of knotted fibres—and the nerves of motion of fibres distinctly cylindrical, but in the nerves of common sensibility the structure has not yet been ascertained.

According to M. John,* grey and white nervous matter differ somewhat in the proportion of their chemical ingredients. The following tables show the chemical composition of the brain as a whole and respectively of the white and grey substances:—

Entire brain (density=1048.)	
Water	77·0
Albumen	9·6
White fatty matter	7 2
Red fatty matter	3·1
Osmazome, lactic acid, and salts	2 0
Earthy phosphates	1·1

	White substance.	Grey substance.
Water	73·0	85·0
Albumen	9 9	7·5
White fatty matter	13·9	1 0
Red fatty matter	0·9	3·7
Osmazome, &c	1·0	1·4
Earthy phosphates	1·3	1·2

Before the student enter upon the investigation of the nervous system of man, he would do well to study the great outlines of this system as found in the inferior animals, particularly in the lower divisions of the vertebrated where the same type of nervous system exist, but of a much more simple form. If he take the brain of the turtle he will find it to consist of 3 pairs of ganglia, the *olfactory*, the *hemispheric* or *cerebral*, and the *optic*, and a single ganglion the *cerebellum* all on the same level and following each other from before backwards in the order now mentioned. In the human brain these subdivisions still exist, but by the extraordinary development of the cerebrum and cerebellum, the other ganglia seem to be swallowed up or transformed into small processes or appendages of the cerebral mass.

I.—DIVISION. CEREBRO SPINAL AXIS.

The *cerebro-spinal axis* in the human subject should first be *viewed in situ.* When removed, as it should afterwards be, from its osseous encasement, and divested of its membranes, it is found to consist, when traced from below upwards, of the following subdivisions:—1st, The *spinal cord*, the upper extremity of which expands into (2dly) the *spinal bulb* or *medulla oblongata*, above which we find (3dly) the *cerebellum* or little brain, and upon a still higher level, (4thly) the *cerebrum* or great brain.

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* Journal de Chemie Medicale, as quoted by Solly.

..—SPINAL CORD.

Situation.—Spinal canal. *Form.*—Irregularly cylindrical. *Extent.*—From the medulla oblongata which constitutes its upper extremity, to the second lumbar vertebra, and presents *an anterior* and *a posterior surface*, each divided into two equal parts by a longitudinal groove :—*lateral surfaces* marked by the attachments of the spinal nerves—an *upper extremity*, continuous with the spinal bulb, and a *lower extremity* terminated by an oval tubercle. A transverse section of the cord demonstrates the *grey neurine* that lies internally. The experiments of Dr Marshall Hall *prove* that, the spinal cord is not only a conductor but a generator of power to the muscles, and that it is an *axis* to the incident excitor and to the reflex motor nerves.

II.—SPINAL BULB OR MEDULLA OBLONGATA

Situation.—Within the cranium, resting upon the basillary process of the occipital bone, and stretching from the commissure of the cerebellum to the foramen magnum of the occipital bone. *Form.* Irregularly conical, flattened from before backwards, symmetrical and divisible into six eminences—the two *corpora pyramidalia anteriorly*, more *laterally* the two *corpora olivaria*, and posteriorly, the two *corpora restiformia.* At the bottom of the groove that separates the corpora olivaria from the restiformia, the *tractus respiratorius* of Sir Charles Bell is found extending downwards upon the lateral parts of the spinal cord.

III.—CEREBELLUM.

Situation.—Inferior occipital fossæ, bounded above by the *tentorium* surmounted by the posterior lobes of the cerebrum. *Form.* Symmetrical and corresponding with the cavity in which it is lodged. *Size.* About one-tenth of the encephalic mass. *Weight.* In the male about 5 ounces, and in the female about 4½ ounces, its density however being somewhat greater in the *female* than in the male.

The student should attend to the following particulars—1st, its external surface.—*a*, *Superiorly* where it is depressed laterally, and elevated mesially into the *superior vermiform* process.—*b*, *Inferiorly*, presenting in its mesal line the *valley* and *inferior vermiform* process.—*c*, Its circumference—2d, The arrangement of the laminæ or plates, both larger and smaller, of which it is composed—3d, Its communications or connections with the spinal cord by the corpora restiformia and pyramidal : with the *cerebrum* by the *valvula Vieusenii* or processus a cerebello ad testes, and the union of its opposite halves by the *commissure* of the cerebellum or *annular protuberance*—4th, the ventricle of the cerebellum or fourth ventricle which is bounded *anteriorly* by the medulla oblongata which is marked by a depression called calamus scriptorius—*laterally*, by the continuations upwards of the corpora restiformia—*posteriorly*, by the cerebellum: the *upper end* of the ventrical is closed by the valvula Vieusenii, and *lower end* is shut by a dense membrane of greyish colour, probably a modification of the pia mater—5th, the situation of the *corpus dentatum*, a nucleus of grey matter embedded in the white, and seen by a vertical section of either lobe of the cerebellum at the junction of its inner, with its two outer thirds, the same section exposing the *arbor vitæ*, formed by the peculiar arrangement of the white and grey neurine.

Although it is convenient to trace both nerves of motion and general sensibility from the same centre, as the brain, spinal cord, &c., still it must be remembered that the nerves of motion only are conductors of volition outwards, or from the nervous centres to the muscles, and that the nerves of sensibility conduct their perceptions inwards, from the organs of sensation to the central nervous masses. Hence we ought in strict language to speak of the motive nerves as *arising* from the brain and spinal cord, and the sensitive from the organs and textures upon which they ramify.

IV.—CEREBRUM.

Situation.—Occupying the greater part of the cranial cavity. *Form.* Ovoidal.—Convex superiorly, the largest extremity turned backwards, compressed to a greater or less degree laterally, and flattened inferiorly—corresponding accurately with the cavity in which it lies, and divided into the right and left hemispheres by a deep fissure. *Weight.* In the male about 40 ounces, and in the female about 37½ ounces. In the male the cerebral substance is also more dense than in the female.

The brain may be examined by the student, first, according to the *old system*, and afterwards according to the newer and more approved plan. He must first get acquainted with all parts that lie upon its *periphery* or external surface:—the form, situation, and direction, of the *convolutions* and depth of the *sulci*, and then by dissecting the brain from *above*, expose its *cavities* or *ventricles*, and the *processes* that are viewed as lying in these chambers.

The following points should be noted. The *two grand divisions* of the cerebrum or the *Hemispheres:*—the various *aspects* or surfaces of each:—as the *commutual* turned to the central fissure:—*the superior:*—the *lateral* and the *inferior* or *base: Processes in mesial line of the base as they appear from behind forwards:*—1st, junction of the crura cerebri at the anterior margin of the *nodus cerebri*—2d, locus perforatus—3d, corpora mammillaria—4th, tuber cinereum—5th, pituitary gland—6th, commissure or junction of optic nerves. *Processes on lateral parts of the base*:—1st, posterior lobe—2d, middle lobe—3d, anterior lobe, the *fissura magna Sylvii* separating the anterior from the middle lobe—4, The crura cerebri—5th, Cerebral nerves.

The *interior* of the cerebrum is exposed from above by removing the hemispheres upon a level with the *corpus callosum* or *commissura superior*, and raising that *commissure*. The *ventricles* of the *cerebrum* are the TWO LATERAL consisting each of three prolongations or *cornua*, the fossa sylvii or FIFTH ventricle and upon a lower level on the mesial line of the brain the THIRD ventricle. *Processes in superior horns of lateral ventricles*: 1st, corpora striata—2d, teniæ semicirculares geminum—3d, thalami nervorum opticorum—4th, choroid plexus, which from opposite sides unite under the anterior part of the fornix in the *foramen of Munro* and at the *foramen commune anterius* —an opening situated at the anterior margin of the *commissura mollis*—the foramen commune *posterius* being situated at the posterior margin of the same commissure. *Boundaries of the Superior Horns*. *Above*, by the corpus callosum: *below*, by the *fornix* and processes in superior horns: *externally* by the fibres of the hemispheres, and *internally*, by the *septum lucidum*, which forms a partition between the lateral ventricles, and between the laminæ of which, the *fifth* ventricle is found. *Process in Posterior Horn.*—Hippocampus minor. *Processes in Lower Horn.*—1st, cornu ammonis—2d, tenia fimbriata—3d, plexus choroides.

THIRD VENTRICLE. *Situation*. A fissure between the thalami nervorum opticorum, and *bounded above* by the *commissura mollis* which is covered immediately by the *velum vasculosum*, and immediately above this last lies the fornix: *below*, by the *locus perforatus* and *tuber cinereum* in the base of the brain:—*anteriorly* by the rounded cord called *anterior commissure* under which a canal leads off to the pituitary gland (*iter a tertio ventriculo ad glandulam pituitariam.*): *posteriorly*, by the *posterior commissure*, the *corpora quadrigemina* and *pineal gland*. Under the posterior commissure a canal passes off to the *fourth ventricle*, or ventricle of the cerebellum—the *iter a tertio ad quartum ventriculum*, or *aqueduct of Sylvius*.

According to the new method of demonstrating the brain, its fibres are traced from below upwards, and the relationships of all the parts more easily seen and comprehended.

The brain may be viewed as consisting of the following grand subdivisions:—

1. *Nuclei* or *Ganglia* of grey matter that are so many sources of power whatever that power may be.

2. Tracts of white matter that pass through the ganglia, and which receive a reinforcement as they pass through to radiate to the convolutions.

3. Tracts of nervous matter or *commissures*, that connect and unite, or communicate with different parts of the cerebral mass.

The *ganglia* of the *whole* encephalic mass when enumerated from below, are the following:—1st, those of the corpora olivaria, or the *pneumogastric*—2d, those of the corpora restiformia, or *auditory*—3d, those that form the corpora dentata, or *cerebellic*——4th, those of the corpora quadrigemina, or *optic*—5th, those of the thalami nervorum opticorum or *sensitive* or *inferior great cerebral*—6th, those of the corpora striata or *superior great cerebral* or *motive*—7th, the *olfactory*—8th, the *hemispheric* or *intellectual.*

The *radiating fibres* may be viewed as of *two* kinds, or form *two* tracts—1st, those fibres continued upwards from the *pyramids.* These send a fasciculus to the cerebellum, pass upwards through the *Pons*, then forming part of the crus cerebri and penetrating the anterior, or motive ganglion, are lost in the grey matter upon the surface of the convolutions, or upon the *hemispheric ganglion.*

And, 2d, Those continued upwards from the *restiform bodies.* These are partly lost in the cerebellum, the remaining fibres extending upwards as part of the crura cerebri, traverse the *posterior* or *inferior*, or *sensitive ganglion*, and radiate to the periphery, or hemispheric ganglion.

The *Commissures*, or apparatuses of communication, are of *three* kinds—1st, those that connect parts in the opposite hemispheres (transverse commissures); 2d, those that connect different parts in the same hemispheres (longitudinal commissures); and, 3d, *those*, which connect the cerebrum to other encephalic masses.

The transverse commissures are, when enumerated from below, 1st, commissura anterior—2d, commissura posterior—3d, commissura pinealis—4th, commissura mollis—and, 5th, commissura superior, or corpus callosum.

The longitudinal commissures, when enumerated from below, are, 1st, tenia semicircularis geminum—2d, the fornix—and, 3d, the superior longitudinal.

Those that connect the cerebrum to other ganglia, are, 1st, the *oblique commissure* the valvula Vieusenii, or processus è cerebello ad testes—2d, olfactory commissure.

According to the new mode of demonstrating the brain, ventricles or shut cavities are not found, but simply a fissure continued upwards between the two lateral divisions of the encephalon, from the posterior fissure of the spinal cord, and that fissure modified into species of cavities by the arrangement of the commissures.

The functions of the different parts of the nervous system have been investigated in three different ways by physiologists. Some have drawn conclusions from experiments performed upon the inferior animals; others have relied chiefly upon the effects of disease; and others, so far as the brain is concerned, have endeavoured to draw conclusions from the peculiarities of form and development existing in the heads of different and living individuals.

These are all legitimate modes of investigating the subject, and calculated mutually to assist each other. At present it must be admitted that much doubt and obscurity overhang the subject, and which can only be expelled by accurate observation, and carefully conducted experiment.

MEMBRANES OF THE BRAIN.

These membranes are three in number—1st, dura mater—2d, tunica arachnoidea—3d, pia mater.

Dura Mater.

Situation.—Occupying the interior of the cranium and spinal canal. *Structure.* A dense pearly coloured fibro-serous membrane, that forms an internal periosteum for the cranium—a protecting envelope for the brain, and a secure lodging place for the *great veins* or *sinuses* of the cerebral organ. *Processes:*—1st, falx cerebri—2d, tentorium cerebelli—3d, falx cerebelli.

Tunica Arachnoidea.

Situation.—Lines the interior of the dura mater, both in the cranium and spinal canal from which it is reflected upon the spinal cord, and exterior of the brain; and, according to Bichat, lines also the ventricles. *Structure.* A serous membrane which forms a shut sac.

Pia Mater.

Situation.—Under the arachnoid membrane, covering every part of the exterior of the brain, passing down between its circumvolutions, and prolonged into its internal cavities. *Structure.* A cellular tunic, the seat of the blood-vessels of the brain.

MEMBRANES OF THE SPINAL CORD.

These membranes are four in number—1st, *dura mater*—2d, *tunica arachnoidea*, both continuations of the corresponding membranes of the brain—3d, *ligamentum dentatum*, a thin but dense membrane which stretches along the lateral parts of the spinal cord, between the anterior and posterior roots of the spinal nerves—4th, *proper membrane* of the spinal marrow, corresponding with the *pia mater*, but differing materially in density.

I.—DIVISION.

OF THE NERVES.

Nerves are cellulo-neurinous cords, of a white or whitish colour, attached by *one* of their extremities to a nervous *mass* or centre, as the brain, spinal cord, or a ganglion; and by the *other* to a sensitive, muscular, or some other organ or texture of the body. Like the muscles, nerves may be viewed as of two kinds, 1st, those of relative or phrenic life; and, 2d, those of vegetative life. In the first class are included, 1st, nerves of sensation, viz., the olfactory, optic, gustatory, auditory, and tactile—2d, nerves of motion, including also those of the respiratory movement.

The nerves of vegetative life seem to be all of one kind, controlling, or at least intimately associated with the nutritive or organic actions or functions of the system.

Each nerve is, 1st, attached by one of its extremities to a nervous centre; 2dly, Is continued for some way as a nervous trunk; and, 3dly, divides into branches, which, after successive subdivisions, are prolonged into the minuter textures of the organ. Every nerve is found to consist of a greater or less number of fasciculi or bundles, and these bundles, again, of primitive nervous filaments which lie in *juxtaposition*, but do not anastomose at any point between their origin and termination.

The nerves terminate in the following organs and textures: 1st, the special organs of sensation—those of sight, hearing, smell, and taste—2d, the skin—3d, the muscles—4th, the mucous textures—5th, the secreting glands—6th, the bones. According to Müller, the nerves terminate in the three following ways:—1st, some by anastomosing loops between every two fibres—2dly, others unite and form a network like blood-vessels; and, 3dly, others in an isolated manner.

Nerves have not been traced into the following textures:—1st, the fibrous—2d, the fibro-cartilaginous—3d, the lymphatic glands—and, 4th, the serous membranes.

After piercing the dura mater, the nerves are surrounded by a sheath of condensed cellular membrane, called the *neurilemma*, which first forms a general investment for the nerve, then sends off secondary sheaths for the larger cord-like subdivisions, and these again transmit inwards more delicate sheaths that surround the minuter filaments.

Among the nerves both of phrenic and vegetative life, we find Plexuses and Ganglia, but their uses are not fully ascertained.

A *Plexus* is formed by the interlacing to a greater or less degree of different nerves. In each plexus the following points require to be noted:—1st, the number and size of the nerves that enter the plexus—2dly, the mode in which they communicate, or the interlacement is effected—3d, the branches that *leave* the plexus, and the relationship in continuity and size which they bear to the nerves that enter the plexus. Although plexuses are found in various parts of the body, yet the largest and most remarkable are those formed by the nervous trunks of the upper and lower limbs.

A *Ganglion* or nerve-knot is formed essentially of neurinous globules of a particular kind, and of filaments or fasciculi of filaments, some of which, as they pass through the ganglion, form a plexus, while others interlace around the globules of the ganglion.

These bodies which vary in form and size may be arranged into three classes—1st, ganglia of sensitive nerves—2d, ganglia of organic nerves—and, 3dly, ganglia of both sensitive and organic nerves. The first are found at the posterior root of all the spinal and of some of the cerebral nerves: the second belong to the great sympathetic, and confined to the *trunk* near the spine; and the third are related in a peculiar manner to the special organs of sensation, and are situated on the head.

ENCEPHALIC NERVES.

According to Willis, *nine* pairs of these nerves exist, but the arrangement of Arnold, who makes twelve pairs of such nerves is simpler and truer to nature.

1. *The First is the Olfactory.*
2. *The Second, the Optic.*
3. *The Third, the Oculo-motory.*
4. *The Fourth, the Trochlearis Oculi, or Patheticus.*
5. *The Fifth, the Trifacial.*
6. *The Sixth, the Abducens Oculi.*
7. *The Seventh, the Facial, or Portio dura.*
8. *The Eighth, the Auditory, or Portio mollis.*
9. *The Ninth, the Glosso-pharyngeal.*
10. *The Tenth, the Pneumo-gastric.*
11. *The Eleventh, the Spinal Accessory.*
12. *The Twelfth, the Myo, or Hypo-glossal.*

[The following is a short statement of the *Origin*, *Course*, and *Distribution* of the nerves.]

1*st*, *Olfactory.*

This nerve is usually described as *arising* by three roots from the fissure that separates the anterior from the middle cerebral lobes, and as *coursing* along the inferior surface of the anterior lobe as far as the *crista galli*, when it forms a *ganglion*, from which the olfactory nerves proceed through the cribriform plate of the ethmoid bone to the lining membrane of the nose. The olfactory nerve or nerves ought to be viewed as arising from the *olfactory ganglion* at the side of the crista galli, and that the part of the so-called nerve, which lies between the cerebrum and that ganglion, should be viewed as a *cerebral commissure* and not as a nerve.

2. *Optic Nerve.*

Origin.—1st, corpora quadrigemina—2d, corpus geniculatum externum—3d, attached by its outer margin to the crus of the cerebrum. *Course.* After the nerves of the opposite sides wind round the crura cerebri, and unite anterior to the pituitary fossa, they separate, and each enters its respective optic foramen, stretches to the posterior aspect of the globe of the eye which it penetrates, and terminates in the retina or nervous tunic of the eye.

3. *Oculo-Motory.*

Origin.—Inner surface of the crus cerebri. *Course.* Obliquely forwards and outwards to the posterior extremity of the cavernous sinus, embedded in the superior wall of which it stretches to the sphenoidal fissure and enters the orbit. *Distribution.* Upon five muscles—rectus superior, levator palpebræ superioris, rectus internus—rectus inferior, and obliquus inferior.—It also sends a filament to the lenticular ganglion.

4. *Pathetic.*

Origin.—Valvula Vieussenii, or processus a cerebello ad testes. *Course.* Betwixt the cerebrum and cerebellum, and along the free margin of the tentorium. At the posterior clynoid process of the sphenoid bone, it enters a canal in the superior wall of the cavernous sinus—penetrates the orbit by the sphenoidal fissure, and ramifies on the superior oblique muscle of the eye.

5. *The Trigeminal, or Trifacial.*

Origin.—By two roots, an anterior and a posterior, from the longitudinal fibres of the nodus cerebri near the crus cerebelli. *Course.* Forwards to the superior margin of the petrous portion of the temporal bone, about four lines from the posterior clynoid process. There it passes into an opening of considerable size, formed by the separation of the layers of the dura mater, and swells out into a flattened semilunar plexiform body, (Gasserian ganglion,) from which *three* nervous *divisions* proceed, 1st, a superior called ophthalmic—2d, a middle called superior maxillary—and, 3d, an inferior called inferior maxillary.

1*st Division, or Ophthalmic*—*Course.* Forwards and upwards to the sphenoidal fissure, behind which it usually divides into three branches, which pass separately through the fissure into the orbit; one extends to the forehead, a second to the lachrymal gland, and a third to the nostril. *Branches:* —1st, frontal, which divides into supra-orbital and supratrochlear—2d, lachrymal—3d, nasal, which sends off the infratrochlear.

2d Division, or Superior Maxillary.—*Course.* The nerve leaves the cranium by the foramen rotundum, and stretches forward to the floor of the orbit: it then enters the infra-orbitary canal, along which it passes, and appears upon the face at the infra-orbitary foramen. *Distribution.* Besides communicating with the spheno-palatine ganglion, it supplies in part, the orbit, the grinding teeth, the antrum, the front teeth, and, by its terminal branches, the upper lip, the nose, and cheek. *Branches :*—1st, orbital—2d, posterior dental—3d, anterior dental—4th, infra-orbitary.

3d Division, or Inferior Maxillary.—*Origin.* 1st, external and posterior part of the Gasserian ganglion—2d, longitudinal fibres of the nodus cerebri. *Course.* Both portions of this division pass out of the cranium by the foramen ovale, and unite at the upper part of the zygomatic fossa. The trunk which is thus formed, descends between the pterygoid muscles, and after supplying the muscles of the jaw, cheek, and ear, it divides into two principal branches, one of which supplies the tongue, and the other the lower jaw and teeth, and the lower lip. *Branches :*—1st, deep temporal—2d, masseteric—3d, buccal—4th, pterygoid—5th, gustatory—6th, inferior dental—7th, auricular.

6. *Abducens oculi.*

Origin.---Superior extremity of the corpus pyramidale. *Course.* Forwards, upwards, and outwards, to the margin of the vertical plate of the sphenoid bone below the posterior clynoid process. It there pierces the dura mater, and traverses the cavernous sinus in contact with the carotid artery. In that sinus it receives some filaments from the superior ganglion of the great sympathetic nerve, and thus reinforced, it soon leaves the sinus, enters the orbit by the sphenoidal fissure, and ramifies upon the ocular surface of the abductor muscle of the eye.

7. *Facial or Portio dura.*

Origin.—Superior part of the groove which separates the corpus olivare from the corpus restiforme. *Course.* Forwards, upwards, and outwards, to the internal auditory foramen, into which it enters—passes more particularly into the aqueduct of Fallopius—and issues out at the stylo-mastoid foramen. Whilst the nerve is imbedded in the bone, it receives an accompanying branch (the superior vidian)—a branch which enters by the hiatus Fallopii, and joins the facial for some way, then leaves it, crosses the tympanum—passes through the glenoid fissure to join the gustatory nerve, and terminates in the submaxillary ganglion. *Distribution.* Whilst passing through the temporal bone, the facial supplies the muscles of the internal ear, and after clearing the stylo-mastoid foramen, and supplying the external ear, the digastric and styloid muscles, it divides into two grand branches which stretch forward in a radiating manner, and supply the face and upper part of the neck. *Branches:*—1st, posterior auricular—2d, temporal—3d, malar—4th, buccal—5th, supra-maxillary—6th, infra-maxillary and cervical.

8. *Auditory, or Portio Mollis.*

Origin.—Corpus restiforme. *Course.* In company with the facial nerve, it proceeds to the auditory canal, into which it enters, and divides into two branches; one which terminates in the cochlea, and the other in the vestibule and semicircular canals.

9. *Glosso-pharyngeal.*

Origin.—From the groove betwixt the corpus olivare and restiforme, below the origin of the facial nerve. *Course.* It leaves the cranium by the foramen lacerum posterius, and runs obliquely downwards and forwards along the posterior aspect of the glosso-pharyngeus muscle to the upper part of the pharynx and inferior surface of the tongue. *Distribution.* Besides communicating with the superior vidian, facial, pneumo-gastric, and cardiac nerves, it supplies the auditory canal, the tongue, the upper part of the pharynx, and the mucous coverings and appendages of these parts.

10. *Pneumo-gastric.*

Origin.—Groove betwixt the corpus olivare and restiforme, immediately below the origin of the former nerve. *Course.* It issues from the cranium by the foramen lacerum posterius, descends upon the neck between the carotid artery, and internal jugular vein, and enters the thorax; on the right side, it crosses the anterior aspect of the subclavian artery, and on the left, the arch of the aorta.—Having entered the thorax, it stretches backwards by the root of the lungs, and attaches itself to the œsophagus, along which it passes betwixt the crura of the diaphragm, to the stomach. *Distribution.* In the *neck* it supplies the pharynx, the larynx, and the heart; in the *thorax*, the lungs and œsophagus; and in the *abdomen*, the stomach, on which it may be said to terminate, although it here also communicates with the branches of the great sympathetic nerve, as it does in the upper part of the neck with the spinal accessory, glosso-pharyngeal, first cervical ganglion, and hypoglossal nerves. *Branches:*—1st, pharyngeal—2d, superior laryngeal—3d, cardiac—4th, inferior laryngeal—5th, pulmonary—6th, œsophagean—7th, gastric.

11. *Spinal Accessory.* (*Superior External Respiratory of Bell.*)

Lateral part of the spinal cord in the neck. *Course.* It ascends in the vertebral canal betwixt the anterior and posterior roots of the cervical nerves; enters the cranium by the foramen magnum, and leaves it immediately again by the foramen lacerum posterius. From the base of the scull it runs downwards and outwards, pierces the sterno-mastoid muscle, and gains the anterior, or internal surface of the trepezius, upon which it is lost. In its course, it communicates with the pneumo-gastric, hypo-glossal, and cervical plexus of nerves.

12. *Hypo-Glossal.*

Origin.—Groove betwixt the corpus olivare and pyramidale. *Course.* It passes out of the cranium by the anterior condyloid foramen, and descends to opposite the angle of jaw, when it turns forwards along the lower margin of the digastricus muscle, and terminates on the tongue.

SPINAL NERVES.

The spinal nerves proceed in pairs from the sides of the spinal cord, each nerve arising by two roots—an anterior or abdominal, and a posterior or dorsal. The *anterior* being exclusively nerves of motion, and the *posterior* of sensibility. The posterior *root* of each nerve passes through a ganglion, and then unites with its anterior root; the compound nerve thus formed, passes then through a foramen conjugale, and divides into an anterior and posterior *branch*, which supply parts respectively on the anterior and posterior aspects of the trunk.

The spinal nerves are usually arranged into the cervical, eight pairs—the dorsal, twelve pairs—the lumbar, five pairs—the sacral, five or six pairs.

CERVICAL NERVES.

Sub-occipital, or 1st cervical. *Course.* Issues from the spine betwixt the posterior arch of the atlas and occiput, and divides into two branches. The *anterior* branch stretches as far as the transverse process of the atlas; it then descends anterior to that process, and after supplying the recti antici, and coursing along the vertebral artery, it terminates by communicating with a branch of the second cervical. The *posterior* branch turns backwards, communicates with the posterior branch of the nerve below, and ramifies upon the occiput.

Second Cervical.—Leaves the spine betwixt the transverse processes of the first and second vertebræ. The *anterior* branch supplies the levator scapulæ, splenius, first intertransversalis colli and rectus capitis anticus major. It communicates with the nerve above, with the superior cervical ganglion, with the pneumo-gastric, and with the nerve below, and assists in forming the superficial cervical plexus. The *posterior* branch turns backwards and upwards—supplies the muscles at the upper and posterior part of the neck, and terminates on the occiput.

Third Cervical.—Leaves the spinal canal between the second and third cervical vertebræ, and divides into two branches. The *anterior* stretches forwards and outwards, communicates with the second, or nerve above, with the corresponding branch of the nerve below, and with the great sympathetic nerve; it supplies also the rectus capitis anticus major and levator scapulæ. The *posterior* branch communicates with the nerve above and below, supplies the muscles on the back of the neck, and the integuments of the neck and head.

Fourth Cervical.—Leaves the spinal canal between the third and fourth cervical vertebræ, and divides into an anterior and posterior branch. The *anterior* branch communicates with the superior cervical ganglion, with the anterior branches of the third and fifth cervical nerves, and contributes to the formation of the cervical plexus. The *posterior* branch, after leaving the spine, passes between the complexus and semi-spinalis colli muscles, and after supplying the muscles in that region, terminates in the integuments.

CERVICAL PLEXUS.

Formed by nerves from the anterior branches of the second, third, and fourth cervical, it communicates with the sub-occipital above, with the brachial plexus below, with the great sympathetic upon the tracheal side, with the spinal accessory upon the external side, and transmits the following branches:—*upwards*, 1st, mastoid—2d, auricular—3d, superficial cervical; and *downwards*, 1st, communicans noni—2d, phrenic—3d, supra-clavicular—4th, supra-acromial—5th, sub-clavicular—6th, profound cervical.

Phrenic.—*Origin.* Cervical plexus, more directly from the anterior branch of the fourth cervical. It receives also a twig from the third, and a branch or two from the brachial plexus and from the great sympathetic. *Course.* Descends upon the lateral and anterior part of the neck; first, between the rectus capitis anticus major and scalenus anticus, then crosses obliquely to the anterior margin of that muscle, and passes into the thorax betwixt the subclavian artery and vein. It then lies anterior to the roots of the lungs, and descends between the pleura and lateral part of the pericardium, and ramifies upon the diaphragm.

5th, 6th, 7th, 8th, *Cervical.*—These nerves issue from their respective foramina conjugalia, and divide into anterior and posterior branches. The *anterior* branches each, first, communicate with the great sympathetic, and then unite to form the *brachial plexus*. The *posterior* branches proceed obliquely outwards and downwards between the semispinalis colli and complexus muscles, traverse the more superficial muscles of the neck, all of which they supply, and ramify upon the integuments of the neck and upper part of the back.

BRACHIAL PLEXUS.

Formed by the union and interlacement of the anterior branches of the four inferior cervical, and first dorsal nerves. *Form.* Quadrilateral, but narrower in the middle than at the extremities. *Extent.* Stretches from the lateral and inferior part of the neck, to the middle of the axilla. In this course it passes betwixt the scaleni muscles, and under the clavicle, and bears important relationships to the subclavian and axillary arteries and veins. *Branches.* 1st, thoracic—2d, supra-scapulary—3d, infra-scapulary—4th, internal cutaneous—5th, external cutaneous—6th, median—7th, radial, or musculo-spiral---8th, ulnar---9th, circumflex.

1st, *Anterior Thoracic.* — *Origin.* Seventh cervical nerve. *Course.* It passes under the clavicle, crosses anteriorly the axillary artery, and stretches to the anterior wall of the axilla, upon which it ramifies.

2. *Posterior Thoracic.* (*Inferior External Respiratory of Bell.*)—*Origin.* Usually by two roots, from the fifth and sixth cervical. *Course.* Through the axilla, behind the axillary vessels, to the serratus major upon which it chiefly ramifies. In the neck it supplies also the scalenus anterior, and levator scapulæ muscles.

Superior Scapular.—*Origin.* Superior margin of the brachial plexus, or from the fifth cervical nerve. *Course.* Obliquely downwards and backwards, to the superior margin of the scapula, passes under the ligament which converts the supra-scapulary notch into a foramen, and ramifies upon the dorsal muscles of the scapula.

Infra-Scapular.---Two or three branches which vary in their origin, sometimes arising from the axillary nerves, at other times from the posterior aspect of the brachial plexus, and ramify upon the posterior wall of the axilla.

Circumflex.---*Origin.* Two inferior cervical and first dorsal nerves. *Course.* Descends upon the anterior surface of the subscapularis muscles, leaves the axilla betwixt the teres major and minor muscles, turns round the upper extremity of the humerus, and ramifies upon the deltoid muscle.

Internal Cutaneous.---*Origin.* First dorsal and last cervical nerves. *Course.* Along the inner side of the upper-arm, under the fascia, and betwixt the median and ulnar nerves. Before it arrives at the bend of the elbow, the branches into which it terminates become more superficial, and ramify on the integuments of the anterior and ulnar aspects of the fore-arm.

External Cutaneous.—Origin. Fifth and sixth cervical nerves. *Course.* After communicating with the median nerve, it descends obliquely outwards behind the coraco-brachialis muscle, and pierces it obliquely; it then lies between the biceps and brachialis anterior. At the bend of the elbow it crosses the median cephalic vein, becomes superficial, and ramifies upon the integuments covering the external part of the fore-arm.

Median.—Origin. Principally from the seventh and eighth cervical and fifth dorsal, but the fifth and sixth cervical also assist. These roots form a kind of nervous ring which surrounds the axillary artery; prolonged from which the nerve descends by the humeral artery to the elbow, and penetrating the muscles of the fore-arm, between the origins of the pronator teres, it transmits a branch which takes the course of the interosseous artery, and then descends between the flexor sublimis and profundus to the carpus, under the anterior annular ligament of which it passes, and is distributed to all the fingers, with the exception of the little finger and ulnar edge of the ring-finger.

Ulnar.—Origin. Last cervical and first dorsal nerves. *Course.* Obliquely downwards and inwards along the inner margin of the triceps. At the bend of the elbow it lies between the internal condyle of the humerus and olecranon, and passes into the fore-arm between the origins of the flexor ulnaris. In the fore-arm it descends upon the inner side of the ulnar artery to the wrist, and after supplying the back of the hand, passes by the os pisiforme into the palm, sends off a deep-seated palmar branch, and supplies also both margins of the little-finger and ulnar margin of the ring-finger.

Musculo-Spiral.—Origin. Posterior aspect of the brachial plexus, more particularly from the sixth, seventh, and eighth cervical, and first dorsal nerves. *Course.* Obliquely downwards, backwards, and outwards—passes between the long and short head of the triceps, and gains the groove on the posterior surface of the humerus. It courses spirally around the bone, and appears at the external margin of the triceps, opposite the insertion of the deltoid, having previously sent off both muscular and cutaneous branches. It then descends between the supinator longus and brachialis anterior, and at the head of the radius sends a large *posterior branch* which supplies the posterior muscles of the fore-arm. The *anterior branch*, the proper radial, is continued along the external aspect of the fore-arm upon the outer side of the radial artery to within a hand's-breadth of the wrist, when it veers backwards, and terminates on the radial side of the posterior aspect of the hand.

DORSAL NERVES.

Number.—Twelve pairs, which resemble the cervical strikingly in their origin—their posterior and anterior ganglionic connections—their transit through their respective foramina conjugalia, and their subsequent division into anterior and posterior branches; the *posterior* branches here supplying the muscles and integuments of the *back*, and the *anterior* branches, the *intercostal spaces* and *thoracic integuments.*

1st, The *anterior* branch of the *first* dorsal, besides supplying the first intercostal space, and receiving a branch from the first thoracic ganglion, unites with the eighth cervical, and constitutes part of the brachial plexus.

2d, The anterior branch of the *second* dorsal nerve receives a branch or two from the second thoracic ganglion—supplies the second intercostal space and neighbouring integuments, and sends off a branch (nervus Wrisbergi), which pierces the external intercostal muscle of that space, and ramifies upon the integuments of the posterior part of the upper-arm.

The anterior branch of the *third* dorsal nerve is similar to the second in its course and distribution. The *brachial* twig is smaller, and ramifies on the integuments near the axilla only.

The anterior branches of the *fourth*, *fifth*, *sixth*, and *seventh* dorsal nerves, supply the corresponding intercostal spaces, and ramify upon part of the external oblique muscle as well as integuments of the abdomen. The anterior branches of the *eighth*, *ninth*, *tenth*, and *eleventh* dorsal nerves supply the corresponding intercostal spaces, the upper part of the abdominal muscles, and a part of the thoracic and abdominal integuments.

The anterior branch of the *twelfth* dorsal nerve, besides receiving, like all the other dorsal nerves, a branch of communication from great sympathetic, sends a branch to the first lumbar, and is then lost in the muscles and integuments of the abdomen.

LUMBAR NERVES.

Number.—Five pairs which resemble the other spinal nerves in their origin, ganglionic connections, transit through the corresponding foramina conjugalia, subsequent division into anterior and posterior branches and in the connection which the great sympathetic nerve has with their anterior. They differ a little in the greater length and obliquity of their roots.

First Lumbar.—Anterior branch. It communicates with the last dorsal, second lumbar, and first ganglion of the great sympathetic, and then constitutes a part of the lumbar plexus. The *posterior* branch turns backwards to the muscles of the loins, part of which it supplies, and terminates on the integuments of the upper part of the hip.

Second Lumbar.—The *anterior* branch presents a three-fold nervous communication; first with the second ganglion of the great sympathetic; second with the anterior branch of the first lumbar; and third with the anterior branch of the third lumbar. It afterwards enters into the formation of the lumbar plexus. The *posterior* branch turns to the muscles of the loins, and besides supplying part of these muscles, ramifies on the integuments of the upper and back part of the thigh.

Third Lumbar.—The *anterior* branch, like the preceding, communicates with three nerves:—with the second and fourth lumbar, and with the third lumbar sympathetic ganglion. The *posterior* branch is similar in course, and distribution to the posterior branch of the preceding nerves.

Fourth Lumbar.—The *anterior* branch communicates with the nerve above and below, and with a ganglion of the great sympathetic. It then constitutes a part of the lumbar plexus. The *posterior* branch which is very small, is lost in the deep-seated muscles of the loins.

Fifth Lumbar.—The *anterior* branch communicates with the nerve above, and with an inferior ganglion of the great sympathetic, and passes into the pelvis to form part of the sacral plexus. The *posterior* branch like the corresponding one immediately above, ramifies upon the deep-seated muscles of the loins.

LUMBAR PLEXUS.

Situation.—Lateral part of the bodies of the second, third, and fourth lumbar vertebræ covered by the psoas magnus muscle. *Formation.* By the union of the anterior branches of all the lumbar nerves. *Form.* Narrow above, and expanded below. *Branches.* 1st, ilio-scrotal—2d, inguino-cutaneous—3d, genito-crural—4th, anterior crural—5th, obturator—6th, lumbo-sacral.

1st, *Ilio-Scrotal.*—*Origin.* First and second lumbar nerves. *Course and Distribution.* Obliquely downwards and outwards to the crest of the ilium, when it divides into two branches, one for the muscles and integuments of the lower part of the abdomen, and the other, which courses along the crest of the ilium and Poupart's ligament, for the scrotum and integuments of the groin in the male, and labium pudendi in the female.

2d, *Inguino-cutaneous.*—*Origin.* Second lumbar nerve. *Course.* It descends for some way by the external margin of the psoas magnus muscle, crosses the iliacus internus, and leaves the abdomen between the anterior superior and anterior inferior spinous processes of the ilium, to ramify upon the integuments of the anterior and external parts of the thigh.

4th, *Genito-Crural.—Origin.* First and second lumbar nerves. *Course.* Descends for some way in the substance of the psoas magnus, issues from the muscle, and runs down upon its anterior surface, covered by the peritoneum. Near Poupart's ligament it divides into two branches, one which enters the inguinal canal, and descends to the scrotum and tunics of the testicle, the other passes under Poupart's ligament anterior to the crural vessels, and ramifies upon the integuments of the inner part of the thigh.

5th, *Anterior Crural.—Origin.* Four superior lumbar nerves. *Course.* Obliquely downwards and outwards from under the psoas muscle, to Poupart's ligament. It descends under that ligament by the external side of the crural artery, and divides into a very considerable number of branches, some of which perforate the fascia lata, and ramify upon the integuments of the inner and anterior parts of the thigh; others are more deep-seated, which descend, some among the *external*, and others among the *internal* muscles of the thigh; amongst these last, one branch *(Internal Saphenic)*, always accompanies the femoral artery, and is continued afterwards along the *vena saphena interna* as far as the great toe.

6th, *Obturator.—Origin.* Second, third, and sometimes fourth lumbar nerve. *Course.* It descends by the inner edge of the psoas muscle into the pelvis, then follows the lateral and superior part of the pelvic walls, a little below the linea innominata, and enters the obturator foramen, having previously transmitted branches to the obturator internus muscle. It passes through the obturator foramen, and supplies the obturator externus, gracilis, and adductor muscles, and communicates with the nervus saphenus internus.

7th, *Lumbo-Sacral.—Origin.* Fourth and fifth lumbar nerve. *Course.* The large trunk formed by the union of these two nerves, descends anterior to the sacrum, near the sacro-iliac junction, and enters into the sacral plexus. In its course it furnishes the *Nervus Gluteus*—a nerve which takes its origin in part from the sacral plexus, leaves the pelvis by the upper part of the sacro-sciatic notch, above the pyriformis muscle, and ramifies chiefly upon the glutæus medius, and minimus muscles.

SACRAL NERVES.

Number.—Five pairs, sometimes six. These nerves arise from the lower extremity of the spinal cord, descend in the lumbar and sacral portions of the spinal canal, and with the lower lumbar nerves constitute the *Cauda Equina.* They arise by two roots like the spinal nerves generally; the ganglia of their posterior roots lie within the sacral canal, and the anterior and posterior branches, into which each lumbar nerve divides, issue out of the spine, the four upper respectively by the anterior and posterior sacral foramina; the fifth by the notch between the sacrum and coccyx; and the sixth, when existing by a notch on the side of that last mentioned bone.

First Sacral.—The *anterior* branch, after issuing from the first anterior sacral foramen, communicates with a sacral ganglion of the great sympathetic, with the lumbo-sacral and second sacral nerves, and then enters into the sacral plexus. The *posterior* branch issues from the first posterior sacral foramen, ramifies upon the posterior muscles of the sacrum, and terminates in the glutæus maximus muscle and integuments of the hip.

Second Sacral.—The *anterior* branch, which escapes by the second anterior sacral foramen, like the nerve above, communicates with the great sympathetic, with the anterior branches of the first and third sacral, and then joins the sacral plexus. The *posterior branch*, having cleared the second posterior sacral foramen, supplies the posterior muscles of the sacrum, and terminates on the glutæus maximus and skin of the hip, and verge of the anus.

Third Sacral.—The *anterior* branch communicates with the great sympathetic, with the second and fourth sacral—sends some filaments to the hypogastric plexus, and then joins the sacral plexus. The *posterior* branch, after leaving the third posterior sacral foramen, is distributed nearly in the same manner as the posterior branch of the nerve above.

Fourth Sacral.—Similar in its course and distribution to the nerve above.

Fifth and Sixth Sacral.—Very small nerves which, like the preceding, divide into anterior and posterior primary branches, which respectively communicate with each other, and with those above and below, and terminate in the muscles of the anus. Sometimes the sixth sacral nerve does not exist.

SACRAL PLEXUS.

Situation.—Lateral and posterior part of the hollow of the pelvis. Formed by the anterior branches of the fifth lumbar, and four superior sacral nerves. These nerves unite and form a thick flat cord, which is continued into the great sacro-sciatic nerve. *Branches:*—1st, hæmorrhoidal—2d, vesical—3d, uterine and vaginal—4th, little sciatic—5th, pudic—6th, great sciatic.

1. *Hæmorrhoidal.* *Number.* Variable. *Course.* Some ascend

along the rectum to the sigmoid flexure of the colon, and others descend to the verge of the anus.

2 *Vesical.—Number.* Variable. *Course.* Across the rectum, to the lateral and superior part of the bladder. Some of the small branches reach the prostate, or urethra of the female.

3. *Uterine and Vaginal*—Are branches which in the female are implicated at their origin with the preceding, cross the rectum, the lower one to the side of the vagina, and the upper to the uterus.

4. *Little Ischiadic.—Origin.* Inferior and posterior part of the sacral plexus, more particularly the second and third sacral nerves. *Course.* Descends upon the posterior part of the hip, anterior to the glutæus maximus muscle, which it supplies as well as the integuments of the perineum and penis; it then stretches down the posterior part of the thigh, and is lost in the integuments. *Branches:*—1st, inferior gluteal—2d, inferior pudendal.

5. *Pudic.—Origin.* Third and fourth sacral nerves. *Course.* It leaves the pelvis at the upper part of the little sacro-sciatic ligament, in company with the pudic artery, and soon divides into two principal branches—an inferior and a superior: the *first* to supply the muscles and integuments of the perineum and urethra; and the *second*, which takes the course of the pudic artery, reaches the dorsum of the penis, and chiefly supplies that organ. In the female, the anterior branch supplies the labium pudendi, and the inferior the clitoris.

6. *Great Ischiadic.—Origin.* Continued from the sacral plexus, all the roots of which enter into its formation. *Course.* This large nerve stretches from the pelvis along the back of the thigh and leg, to the sole of the foot, and in its course supplies the posterior muscles of the thigh, the anterior muscles of the leg, and the integuments of the anterior part of the leg, and upper part of the foot. It likewise supplies the posterior muscles and integuments of the leg, and terminates in the muscles and skin of the sole of the foot. The student should particularly observe its relations to the parts—1st, in the hip—2d, in the thigh—3d, in the leg—4th, in the foot. *Branches:*—In the ham it divides into two grand branches, 1st, the external popliteal, or *fibular*—and, 2d, the internal popliteal, or *tibial.* The *fibular* sends the following branches, 1st, external saphenal (in part)—2d, musculo-cutaneous—3d, anterior tibial. The *tibial* furnishes the following—1st, external saphenal (in part)—2d, internal plantar—3d, external plantar.

DIVISION III.—GANGLIONIC SYSTEM OF NERVES,

Or Great Sympathetic Nerve.

This system of nervous matter consists of numerous nervous knots or ganglia, so connected together by nervous cords, as to constitute a chain of nervous matter on each side of the body, that stretches from the orbitary palatine and nasal fossæ along the sides of the vertebral column to the coccyx, and which transmits numerous filaments to the vital organs, and to all the organs of the body. This system may be viewed as consisting of, 1st, ganglia; 2d, nervous filaments, that proceed from the ganglia.

The following is an *arrangement* of the *ganglia*, and a short notification of the *nerves* that proceed from them.

1. *Ganglia of the Head:*—1st, lenticular—2d, spheno-palatine—3d, naso-palatine—4th, otic—5th, sub-maxillary.

2. *Ganglia of the Trunk:*—*Three cervical*—a superior, middle, and inferior: *twelve dorsal*, which correspond with the twelve vertebræ: *five lumbar*, and *four sacral.*

OPHTHALMIC GANGLION.

Situation.—In the orbit betwixt the optic nerve and abductor oculi muscle. *Form.* Quadrilateral and very small. *Branches:* The *entrant* are, a filament of the nasal branch of the ophthalmic, transmitted from the great sympathetic, and a filament of the common motor nerve of the eye; the *egredient* are, the *ciliary nerves*, twelve or fourteen very small nerves which proceed along the optic nerve to the sclerotic coat, which they pierce, then continue their course betwixt the sclerotic and choroid coats of the eye to the ciliary circle, and from that to the iris.

SPHENO-PALATINE GANGLION.

Situation.—Outer orifice of the spheno-palatine foramen. *Form.* Triangular. *Branches: entrant*, probably the vidian from the great sympathetic, and superior maxillary from the trifacial: *egredient*—the nasal which proceed to the nose through the spheno-palatine foramen, and the palatine which descend by the posterior palatine canal to the palate.

NASO-PALATINE GANGLION.

Situation.—In the anterior palatine canal. *Form.* Ovoidal.

Branches:—1st, ascending or nasal—2d, descending or palatine. This ganglion is frequently not to be found.

OTIC GANGLION.

Situation.—Immediately beneath the *foramen ovale*, upon the inner side of the inferior maxillary nerve, where the motor division unites with the larger division from the Gasserian ganglion. *Branches.* The *entrant* are a branch or branches of the inferior maxillary, and a filament from the great sympathetic. The *egredient* are branches to the internal muscles of the malleus and the tensor palati muscle.

SUBMAXILLARY GANGLION.

Situation.—Posterior margin of the submaxillary gland. *Form.* Oblong. *Branches. Entrant:* superior vidian, a branch of the great sympathetic, and a filament, or filaments, from the lingual branch of the fifth. *Egredient:* Branches that form a plexus that supplies the submaxillary gland.

CERVICAL GANGLIA.

Number.—Usually three on each side—1st, superior—2d, middle—3d, inferior cervical.

SUPERIOR CERVICAL GANGLION.

Situation.—Upper part of the anterior surface of the vertebral column, extending from the base of the cranium to the transverse process of the third cervical vertebra. *Form.* Fusiform. *Branches:* Ascending, descending, external, internal, and anterior.

MIDDLE CERVICAL GANGLION.

Situation.—Anterior surface of the fifth or sixth cervical vertebra. *Form.* Usually lenticular, but varying much in form. *Branches:* Inferior, external, internal, and superior.

INFERIOR CERVICAL GANGLION.

Situation.—Between the transverse process of the seventh cervical vertebra and head of the first rib. *Form.* Lenticular. *Branches:* Superior, inferior, external, internal, and anterior.

CARDIAC PLEXUSES.

Formed by the three cardiac nerves, which come respectively from the superior, middle, and inferior cervical ganglia, and descend into the thorax. In their course they unite with some filaments of the pneumo-gastric, and behind the arch of the aorta constitute the cardiac plexus from which the heart principally is supplied.

THORACIC GANGLIA.

Number.—Twelve on each side. *Situation.* Anterior to the junction of the ribs with the vertebral column and behind the pleura. *Branches:* 1st, they are connected together by nervous cords—2d, externally a twig or two from each ganglion unites with the anterior branch of the corresponding dorsal nerve, and internally branches are sent off which constitute the splanchnic nerves.

SPLANCHNIC NERVES.

Two on each side, which are distinguished into *great* and *small.*

Great Splanchnic.—Origin. From the sixth, seventh, eighth, ninth, and sometimes tenth thoracic ganglia. The nerve formed by the union of these four or five roots, descends and pierces the crus of the diaphragm, and near the cœliac artery terminates in the semilunar ganglion.

Little Splanchnic.—Origin. Tenth and eleventh thoracic ganglia. The nerve formed by the junction of these two roots perforates the diaphragm, and is principally lost in the renal plexus.

ABDOMINAL GANGLIA.

1. *Semilunar Ganglia and Solar Plexus.*

Number. Two, one on each side. *Form.* Crescentic. *Situation.* Crus of the diaphragm opposite the cœliac artery. *Branches:* Numerous filaments from the two opposite great ganglia meet, interlace, and, with a few filaments of the pneumo-gastric, form the *solar plexus,*—a great nervous network situated behind the stomach, anterior to the crura of the diaphragm and aorta, and which stretches under the form of secondary plexuses, along the branches of the aorta, to all the abdominal organs. Hence we have, as emanations from the solar plexus, a diaphragmatic, a hepatic, a splenic, a gastric, a superior mesenteric, an inferior mesenteric, and a *renal* plexus; which last, however, is formed principally from the little splanchnic nerve, and furnishes in its turn the spermatic plexus.

Lumbar Ganglia.

Number. Five on each side. *Situation.* Lateral and anterior part of the bodies of the lumbar vertebræ, near the anterior margin of the psoas magnus muscle. *Form.* Oblong. *Branches:* 1st, those that connect the ganglia together—2d, those that join the anterior branches of the lumbar nerves—3d, those that stretch across to the spine, and by meeting and interlacing with branches from the opposite side, form the *aortic plexus* which assists somewhat in forming the plexuses from the solar, and besides sending branches along the iliac arteries, is continued into the hypogastric plexus.

SACRAL GANGLIA.

Number.—Usually four on each side. *Situation.* Anterior surface of the sacrum, at the internal margin of the anterior sacral foramina. *Form.* Variable. *Branches:*—1st, longitudinal *connecting cords*—2d, *external*, which join the anterior branches of the sacral nerves—3d, *internal*, which meet with those of the opposite side, and by their interlacement with branches from the inferior mesenteric and aortic plexuses, form the hypogastric plexus.

HYPOGASTRIC PLEXUS.

Situation.—Posterior, and lateral part of the rectum. Formed as stated above, and transmits branches along the ramifications of the hypogastric artery, which both supply the pelvic viscera and extend to the upper part of the thigh.

DIVISION IV.—THE EXTERNAL ORGANS OF SENSATION.

The *Senses* are some of the most remarkable peculiarities of an animal body. They connect us to external nature, and increase to an immeasurable extent the sources of our enjoyment.

The senses are five in number. Of these, one may be called *general* and the other four *special* senses. The general sense is that of *touch*, since it is diffused over the surface of the whole body, and is supplied not by one nerve, but by numerous branches of the nervous system. The special senses are those of *taste*, *smell*, *hearing*, and *vision*, to each of which one nerve is allotted, and the organs confined to certain determinate situations.

I.—THE SKIN, OR ORGAN OF TOUCH.

The Skin is a dense, thick, elastic membrane, forming the general envelope of the body, and continuous at the various orifices with the mucous textures. *External surface:*—Marked by wrinkles of various kinds, and garnished to a certain extent with hairs and with the nails. *Internal surface.* Connected to the subjacent textures, generally by loose cellular membrane. *Structure.* Generally described as consisting of three layers—1st, an external, the epidermis—2d, a middle, the rete mucosum—and, 3d, an internal, the dermis, or cutis vera.

1st, *The Epidermis, or Cuticle.*—A transparent impermeable layer covering the exterior of the body, and generally supposed to consist of numerous small scales in close apposition.

2d, *Rete Mucosum.*—The part in which the colouring matter of the skin resides.

3d, *Dermis, or Cutis Vera.*—The thickest and most complicated layer of the skin, composed of fibrous lamellæ which cross each other, and thus form interstices which lodge the sebaceous follicles and perspiratory glands—supplied by arteries, veins, nerves, lymphatics, and traversed by the hairs. The external surface of the dermis presents numerous elevated points called papillæ—organised bodies in which the sense of tact or touch resides.

According to De Blainville, the skin consists of the *six* following *structures:*—1st, An internal muscular layer existing in some parts of the body only, as in the neck—2d, the dermis or true skin—3d, the vascular net-work—4th, the pigmentous layer—5th, the papillary or nervous body—and, 6th, the epidermis or scarf-skin.

These may be viewed as the essential—and the *accessory* parts are of two kinds—1st, cryptæ or follicular bodies embedded in the skin that secrete fluids for lubricating the cutaneous surface—2d, *external appendages*, as hairs and nails, which commence in bags resembling cryptæ, the secretions of which are solid and more or less permanent.

Such are the component parts of the skin to which the student must turn his attention. Its functions, from the complexity of its structure, are numerous and important. It is a protecting investment, imparting form and beauty to the body. The *papillary body* is the seat of tact or passive touch—the *rete mucosum* or pigmentous layer the residence of the complexion of individuals, and of the colour of the various races of men, and the *epidermis* tempers the sensibility which would otherwise be intolerable. Besides these properties, the cutaneous investment is the seat of absorption and secretion, and an accessory organ of respiration—throwing off a certain proportion of carbon, and taking up a proportional quantity of oxygen.

II.—THE ORGAN OF TASTE AND OF THE TONGUE.

The organ of taste is an apparatus by which we perceive external bodies by one of their properties termed *savour.* The majority of physiologists are of opinion that the tongue is the only seat of this sense. The experiments of Guyot and Admyrauld have shown that this is not the case, and that the sense exists in the following parts—1st, in a spot upon the middle of the velum palati—2d, the root of the tongue behind the foramen cœcum—and, 3d, in the whole circumference of the tongue, but extending more upon its upper than under surface, and exhibiting more acuteness at the apex than at any other part of the circumference. The tongue must still be viewed, however, as the *chief* seat of this sense.

The Tongue.

Situation. Interior of the mouth. *Form.* A truncated pyramid flattened from above downwards, and stretching from the os hyoides to the front teeth. It presents *two surfaces*, a superior and inferior: two lateral *margins*, a *base* and an *apex.*

Superior surface:—Nearly flat, presenting a groove or raphè, which corresponds with the mesial line and septum of the organ, and which, near the posterior extremity of the tongue, terminates in a circular depression (foramen cœcum Morgagni). *Inferior surface.* Partly adherent—partly free, and connected to the floor of the mouth by the frenum linguæ. *Margins.* Rounded, but thicker posteriorly than anteriorly. *Posterior Extremity or Base.* Continuous with the epiglottis and anterior arches of the fauces. *Anterior Extremity or Point.* Thin, semicircular from side to side. *Structure.* 1st, muscles—see muscles of this region. 2d, *arteries*—the lingual, palatine, and tonsillar branches of the facial. 3d, *veins*—ranine and submental. 4th, *nerves*—lingual branch of the fifth, glosso-pharyngeal, and hypo-glossal. 5th, lymphatics. 6th, cellular membrane. 7th, mucous membrane:—Covering—1st, the inferior surface of the tongue—2d, *the superior surface*, which presents a distinct epidermis, under which are the *papillæ* and mucous follicles, which render this surface of the tongue peculiarly unequal. These follicles are the calcynal glands, which vary from nine to fifteen, and are arranged in two oblique lines, which meet at an acute angle posteriorly at the *foramen cœcum.* The *papillæ*, in which the sense of taste resides, are of two kinds—1st, the fungiform—and 2d, the conical. These are studded over the dorsum and margins of the organ, and are highly organised.

A difference of opinion exists regarding the seat of the true gustatory nerve. Galen, Vesalius, Willis, Haller, and the majority of physiologists, say that it resides in the lingual branch of the fifth pair. Boerhaave, that it is the hypo-glossal or ninth of Willis; and Cuvier and De Blainville, that all the nerves that proceed to the tongue concur in establishing the function. The late experiments of Panizza, if correctly stated, lead to the conclusion that the glosso-pharyngeal is the nerve of taste—that the lingual of the fifth communicates common sensibility, and the hypo-glossal motility to the organ. The opinion generally entertained is, that the lingual branch of the fifth is the gustatory nerve.

III.—ORGAN OF SMELL.

The organ of smell may be said to consist of two parts—1st, *the Nose*, commonly so called—and, 2d, *the Nasal Fossæ.*

1. *The Nose.—Situation.* In the mesial line of the face, between the forehead and upper lip, forming a covering for the nasal fossæ. *Form.* Pyramidal, and varying much in dimensions. It consists of the following textures: 1st, skin—2d, muscles—3d, bones—4th, *cartilages*, viz. cartilaginous septum—right and left lateral cartilages—cartilages, or rather fibro-cartilages of the alæ nasi, which usually consist each of two parts, and possess great elasticity. 5th, arteries, veins, lymphatics, nerves, all connected by cellular membrane, and covered internally by a part of the pituitary membrane.

2. *Nasal Fossæ.*—The NASAL FOSSÆ should be investigated with much care by the student. He should advert to the following particulars:—

1st, The *differences* which these cavities display in the skeleton and recent state.

2d, The *form* of the cavities, elongated from behind forwards—narrow superiorly, and wider below—3d, the *boundaries* of each fossa, forming respectively the *roof*, the *floor*, the *external wall*, and the *internal*, or *partition-wall*—4th, the *sinuses* that communicate with these fossæ, viz.—the frontal, the maxillary, the sphenoidal; and, 5th, the *membrane*, in which the sense of smell resides:—a mucous membrane peculiarly organised, which lines the interior of the nose and nasal fossæ, and their communicating cavities. *Adherent surface* fibrous, and constituting a species of periosteum. *Free surface* soft, and presenting numerous villosities. *Structure.* 1st, mucous texture—2d, fibrous texture.

3. *Nerves:—the olfactory*, the essential nerve of smell—branches of the trifacial—branches from the ganglion of Meckel.

4. *Arteries:* branches of the internal maxillary—branches of the ophthalmic—branches of the external carotid.

5. *Veins*, corresponding in general with the arteries.

6. *Lymphatics*, which pass through the glandulæ concatenatæ.

7. *Vibrisæ*, or hairs, situated at the anterior apertures of the nostrils.

8. *Mucus*, forming a protecting covering for the membrane.

IV.—ORGAN OF HEARING.

The organ of hearing is an apparatus by which we perceive bodies by their vibrations, transmitted through the medium in which we live. The effect of these vibrations is called *sound.*

Situation. At the side of the head, and in the petrous portion of the temporal bone, and susceptible of a three-fold subdivision —1st, AN EXTERNAL EAR—2d, A MIDDLE EAR, or *tympanum*—and, 3dly, AN INTERNAL EAR, or *labyrinth.*

1st, *External Ear.*

Consisting of two parts—1st, The auricle or pavilion of the ear—and, 2d, The external auditory canal.

1st, *The Auricle.—Form.* Oval, the longest diameter, vertical, and the largest extremity *superiorly*—presenting *two surfaces*, an anterior or external, and a posterior or internal, and *a circumference* which is free except at the anterior part. *Processes* upon the *anterior* surface—1st, helix—2d, anth-helix—3d, tragus—4th, anti-tragus—5th, lobule.. *Depressions* :—1st, cavitas innominata—2d, scapha—3d, concha. Muscles of the external ear. See page 55.

The *pavilion* of the ear consists of the following textures —1st, a layer of *fibro-cartilage* that forms a species of skeleton of the part—2d, *muscles* that produce a degree of tension and relaxation of its different processes—(see page 55)— 3d, *ligaments*, an anterior, a posterior, and a superior, adapted for fixing it to the head—4th, *arteries*, from the posterior auris and temporal—5th, veins corresponding with the arteries—6th, *lymphatics*—7th, *nerves* from the facial and from the superficial cervical *plexus*—8th, cellular membrane connecting all these textures—and, 9th, skin which covers and adheres closely to the fibro-cartilage.

2d, *External Auditory Canal.* Extending from the concha obliquely forwards and inwards, and curved slightly downwards to the membrana tympani, consisting of the following textures —1st, fibro-cartilaginous portion—2d, osseous portion—3d, lining membrane—4th, ceruminous glands—5th, hairs—6th, cerumen. According to Vaquelin, three substances form the base of cerumen—a fat oil, an albuminous animal mucilage, and a colouring matter.

2. *Middle Ear, or Tympanum.*

Situation. Between the auditory canal and labyrinth. *Boundaries.* 1st, *External wall*, formed chiefly by the membrana tympani—2d, *Internal wall*, or *partition* between the tympanum and labyrinth, which presents an eminence, the *promontory*, and two foramina, a superior, the *fenestra ovalis*, and an inferior, the *fenestra rotunda*—3d, *Circumferential wall*, which presents three openings and two processes—posteriorly, the *opening* into the mastoidean cells, and the process called *pyramid*—inferiorly, the *glenoid fissure*, and anteriorly, the *Eustachian tube*, or iter a palato ad aurem, and *processus cochleariformis*. *Parts within the tympanum* :—1st, *bones* :—malleus, incus, orbiculare, stapes, which are so connected as to form a vibratory chain that stretches from the membrana tympani to the membrane of the fenestra ovalis—2d, *muscles*.—(see page 55)—3d, *nerves* :—branches of the portio dura—glosso-pharyngeal and sympathetic—4th—*lining membrane*.

3. *Internal Ear, or Labyrinth.*

Situation. Boundaries. *Three-fold Division* :—1st, Vestibule—2d, Cochlea—3d, Semicircular canals.

The vestibule, or middle chamber of the labyrinth. *Form* :—Irregularly spheroidal, and divided into two portions by a crest. *Openings* :—1st, fenestra ovalis, in the recent state closed by the base of the stapes—2d, the five orifices of the three semicircular canals—3d, the orifice of the scala vestibuli—4th, the orifice of the aqueduct of the vestibule—5th, numerous exceedingly small openings, which transmit filaments of the auditory nerve and branches of blood vessels.

2d, *Cochlea*. *Situation* :—Anterior part of the petrous portion of the temporal bone. *Form*. A spiral tube divided into two canals or *scalæ*, by a spiral lamina or partition. *Processes* :—1st, modiolus, or conical central pillar—2d, lamina spiralis, which consists partly of bone and partly of membrane. *Canals* :—1st, scala vestibuli—2d, scala tympani—3d, infundibulum—4th, orifice of the aqueductus cochleæ.

3d, *Semicircular Canals*. — Number. Three. *Situation*. Nearer the base of the petrous portion of the temporal bone than the other divisions of the labyrinth. *Names* :—1st, superior or vertical—2d, posterior or oblique—3d, external or horizontal.

Soft parts of the labyrinth :—1st, a delicate periosteum that lines all the *cavities*—2d, the membranous sac of the vestibule sacculus vestibuli, occupying a part only of the vestibular cavity—3d, a membranous bag, utricula communis, filling the remaining part of the vestibule, and communicating with, 4th, the membranaceous tubes of the semicircular canals—5th, the coriaceous membrane of the cochlea—6th, the auditory nerve which ramifies upon these membranes—7th, *blood-vessels:—arteries* :—branches of the posterior auris, internal carotid meningeal and basilary—*veins* :—extremely small, generally two that traverse the petrous portion of the bone, and enter, one into the lateral sinus, and the other into the upper part of the jugular vein—8th, the liquor Cotunnii, by which the membranaceous bags are kept distended, and a fitting medium afforded for transmitting the sonorous vibrations to the sentient surface, each of these bags expanding by one of their extremities into an ampulla, and all of them communicating with the vestibule by both extremities.

V.—THE ORGAN OF VISION.

Situation. Twofold arrangement of the parts entering into the formation of the Eye:—I. Exterior adventitious parts called *Tutamina Oculi*—II. Parts that form the *Globe* of the eye.

I.—TUTAMINA OCULI.

These consist of the following parts—1st, the orbit with the muscles and fat that surround the globe—2d, the eye-brows—3d, the eye-lids—4th, the secreting lachrymal apparatus—and, 5th, excreting apparatus of the tears.

1. *The Orbits.* Pyramidal cavities or sockets for the eyes, each presenting *four walls*—a superior or roof—an inferior or floor—an external or temporal—and an internal or nasal:—a *base* turned forwards and somewhat circular, and an *apex* turned backwards and inwards.

The student must get familiarly acquainted with *every bone* that enters into each wall, and every foramen that communicates with the cavity. *Bones that enter into the formation of the orbit*:—frontal, sphenoidal, ethmoidal, superior, maxillary, lachrymal, malar, palatine. *Foramina and canals that communicate with the orbit*:—optic, sphenoidal fissure, spheno-maxillary fissure, anterior and posterior internal orbitary, inferior maxillary canal, supra-orbitary foramen, lachrymal groove.

2. The *Eye-brows.* Hairy arches *situated* over the upper border of the orbit, into the composition of which the following textures enter—1st, hairs peculiarly disposed—2d, skin—3d, *muscles*:—the occipito-frontalis, the corrugator supercilii, and the orbicularis palpebrarum—4th, arteries, veins, lymphatics, nerves—5th, cellular membrane and fat.

3. The *Eye-lids.* Two movable curtains, an *upper* and a *lower*, placed in the front of the eye, each presenting two *surfaces*, a cutaneous and an ocular; two *margins*, an adherent and a free; two *extremities*, a temporal and a nasal; and by the connection of the upper and lower eye-lids, two *angles* or canthi, the greater or nasal, and the smaller or temporal. *Parts entering into the formation of the eye-lids*:—1st, skin—2d, fibres of the orbicularis palpebrarum muscle—3d, palpebral ligaments,

superior and inferior, that connect the tarsal cartilages to the base of the orbit—4th, in the upper eye-lid the levator palpebræ muscle—5th, tarsal fibro-cartilages, a superior or greater, and an inferior or smaller—6th, Meibomian follicles—7th, ciliæ, or eye-lashes—8th, tunica conjunctiva—9th, arteries, veins, lymphatics, nerves—10th, cellular membrane.

4. *Secreting Lachrymal Apparatus*:—1st, lachrymal gland—2d, caruncula lachrymalis, to which may be added the Meibomian follicles and tunica conjunctiva.

5. *Excreting parts of the Lachrymal Apparatus*:—1st, the seven lachrymal canaliculi that transmit the tears from the lachrymal gland to the tunica conjunctiva—2d, the lachrymal ducts that commence by *two* orifices, puncta lachrymalia, and convey the tears from the inner canthus of the eye to the lachrymal sac—3d, the lachrymal sac—4th, the nasal canal.

II.—GLOBE OF THE EYE.

Situation. Inner and anterior part of the orbit. *Form.* Spheroidal, the greatest diameter being from behind forwards, and the greatest convexity anteriorly; the length of its antero-posterior diameter usually measuring about eleven lines, and the vertical and transverse diameters respectively about ten lines. The globe is *bounded anteriorly* by the tunica conjunctiva; *behind*, by the muscles, vessels, nerves, and fat of the orbit; *above* and to the *external side*, by the lachrymal gland; and *below* and to the *inner side*, by the lachrymal passages.

The globe of the eye may be viewed—1st, as consisting of *tunics* and *lenses*; or 2d, of *transparent* and *non-transparent* textures. One of the lenses, the cornea, is usually viewed as also one of the tunics or membranes; and the retina, although arranged among the tunics, possesses in the living subject a transparency equal to that of the lenses or humours of the eye.

1st, *Tunics or Non-transparent Textures.*

1. *Tunica Sclerotica.*—A dense *fibrous* membrane occupying the four posterior fifths of the eye, into the external or convex surface of which the muscles of the globe are inserted; the four recti muscles being inserted near the cornea, and constituting, by their tendinous attachments, the *tunica albuginea* of some anatomists—*posteriorly* pierced by the optic nerve, at the nasal side of the axis of the globe—*anteriorly* united to the circumference of the cornea—and *internally*, loosely connected to the choroid coat, except near the cornea, where the adhesion is great.

2. *Tunica Choroidea.*—*Situation.* Inner surface of the sclerotic, extending from the entrance of the optic nerve to the iris.

External surface. In contact with the sclerotic coat, and presenting anteriorly the ciliary ligament. *Internal surface.* Coated with *pigmentum nigrum:* a dark-coloured incrustation, usually said to be secreted by the choroid coat, but more probably a peculiarly organised membrane, like the pigmentous layer of the skin. It absorbs the superfluous rays of light. *Structure.* It consists of arteries and veins arranged in a peculiar manner, and connected by delicate cellular tissue; the veins lying externally, and called *vasa vorticosa,* and the arteries forming a more deep-seated layer.

Ligamentum Ciliare.

Situation. Between the sclerotic, choroid, and iris. *Form.* A greyish ring about a line and a half in breadth, into the anterior margin of which the iris appears to be grooved. *Structure.* Soft and pulpy, and traversed by the ciliary arteries and nerves.

Iris.

A variously-coloured membrane, *situated* between the cornea and crystalline lens, in the aqueous humor. *Form.* Circular and flat, and presenting a central perforation, called the *pupil.* *Anterior surface* turned to the cornea, covered by the membrane of the aqueous humor, and presenting two circles of colours—the pupillary and choroideal. *Posterior surface* covered by an adherent black varnish, the *uvea;* upon the removal of which, numerous white lines are discovered converging to the pupillary margin. The *pupillary margin* circular, bounding the *pupil*—an opening, the size of which is affected by the quantity of light reaching the bottom of the eye, and which in the fœtus is closed by the *membrana pupillaris.* The *choroideal margin* is attached to the ciliary ligament, the choroid coat and ciliary processes. *Structure.* The iris is composed of the following textures: 1st, *Arteries*—long and short ciliary; 2d, *Veins*—ciliary or iridal, that pour their blood into the vasa vorticosa, and these again into the ophthalmic vein; 3d, *Nerves*—the iridal from the ophthalmic ganglion; 4th, lymphatics? 5th, cellular membrane; 6th, membrane of the aqueous humor. Muscular fibres are generally supposed to exist, but the opinion is unfounded. Muscular fibres cannot be demonstrated, and the phenomena of the increase and decrease of the pupil can be more satisfactorily explained upon a principle different from that of muscular action. The iris is probably of an *erectile* structure, adapted for moderating the admission of light to the bottom of the eye.

Ciliary Processes.

Number. From seventy to eighty. *Form.* Triangular, but so arranged that the aggregate constitutes a ring—*corpus ciliare*—that like a collar surrounds the margin of the crystalline lens. *Situation.* Behind the iris and ciliary ligament resting upon the anterior surface of the vitreous humor, with corresponding processes of the membrane of which humor they are implicated and connected by blood-vessels. *Structure.* Extremely vascular, but the intimate structure and the uses of these bodies are not known.

3. *The Retina.*—A transparent pulpy nervous membrane. *Situation.* Between the choroid coat and vitreous humor, extending from the optic nerve to the ciliary processes, as sensible retina, and thence to the crystalline lens, as insensible retina. *External surface.* In contact with the inner surface of the choroid coat or its pigmentous layer, by not adhering. *Internal surface.* Enclosing the vitreous humor and its investing membrane. *Structure.* Consisting of three layers—1st, an external serous-like layer, the membrana Jacobiana; 2d, a middle or pulpy nervous layer; and 3d, an internal or vascular layer. At the back part of this membrane, and exactly in the axis of the eye, we find the *foramen centralis retinæ*, a black foramen-like point, but not a foramen surrounded by the *limbus luteus* or yellow circle, first described by Sœmmering. *Use.* The tunic that receives the impression of the rays of light.

2d, *Transparent parts of the Eye.*

The transparent parts of the eye are situated before the retina, and placed in immediate succession from before backwards, and held in their relative position by the tunics. Like the lenses of an optical instrument, they transmit and refract the rays of light. When enumerated from before backwards, they are—1st, the cornea; 2d, the aqueous humor; 3d, the crystalline body or lens; and 4th, the vitreous humor.

1. *The Cornea.*—A transparent membrane, situated at the anterior part of the eye. *Anterior surface.* Convex, and covered by a mucous membrane, probably a modification of the conjunctive. *Posterior surface.* Concave, lined by the membrane of the aqueous humor. *Circumference.* Nearly circular, and adapted to the anterior margin of the sclerotic. *Structure.* Consisting of six laminæ, with intermediate cellular membrane, containing a serosity.

2. *Aqueous Humor.*—A fluid like pure water, but of greater specific gravity, secreted by a delicate serous membrane—the membrane of the aqueous humor—that lines the anterior chamber of the eye, but cannot be traced through the pupil into the posterior chamber. This fluid fills that space of the eye that exists between the cornea and lens, the iris dividing the space into two cavities, the *anterior and posterior chambers of the aqueous humor* which communicate by the pupil.

According to Berzelius, the *aqueous humor* is composed of water 98·10; albumen, a trace; muriates and lactates, 1·15; soda, with a matter soluble in water only, 0·75.

3. *Crystalline Lens.—Situation.* In the axis of the eye, between the aqueous humor which bounds it anteriorly, and the vitreous humor, in a depression of which it is received, posteriorly. *Form.* Lenticular. *Anterior surface.* Convex, free and turned to the posterior chamber of the aqueous humor. *Posterior surface.* More convex than the anterior, and embedded in the vitreous humor. *Circumference.* Surrounded by the *canal of Petit* and the *ciliary body.* *Structure.* Consisting, 1st, of a capsule; 2d, of the liquor Morgagni; 3d, of the *body* of the lens. 1st, *Crystalline Capsule.* A transparent membrane which forms a bag without an aperture, enclosing the lens without adhering to it, and frequently referred to as consisting of an anterior and a posterior segment. 2d, *Liquor Morgagni*—A transparent fluid sometimes found between the capsule and the body of the lens, probably exuded after death. 3d, *The Body of the Lens*—By exposure, the lens breaks up into three or four segments, each of which is composed of concentric laminæ, which increase in density from the circumference to the centre, and the laminæ are composed of fibres. *Use.* To transmit and refract the luminous rays.

According to Berzelius, it consists not of albumen, as was at one time imagined, but almost entirely of water and a peculiar substance analogous in many of its chemical properties to the colouring matter of the blood.

4. *Vitreous Humor.*—A transparent gelatinous-like mass, occupying the three posterior fourths of the concavity of the eyeball. *Form.* Spherical but depressed anteriorly, for lodging the crystalline lens. *Structure.* It consists of a fluid similar to that of the aqueous humor, and of the *hyaloid membrane.*

The *Hyaloid Membrane* is composed of a mass of cellules that contain the fluid. Near the equatorial margin of the *lens*, the membrane appears to divide into two laminæ, one of which is attached to the anterior, and the other to the posterior surface of the lens, and the *canal of Petit* formed around the margin of the lens by the separation of the laminæ.

The chemical composition of the vitreous humor, according to Berzelius is nearly the same as that of the aqueous.

Experiments on the comparative refractive powers of the humors of the eye were performed conjointly by Drs Brewster and Gordon, and the following are the results:—The refractive power of water being taken at 1·3358; aqueous humor, 1·3366; vitreous, 1·3394; outer layer of crystalline, 1·3768; middle layer of crystalline, 1·3786; central part of crystalline, 1·3990; whole of crystalline, 1·3839.

PART IV.

ORGANS OF DIGESTION.

The organs of digestion may be examined either under a physiological or an anatomical arrangement. The *first*, including the organs concerned in the following subordinate acts of digestion, viz., 1st, mastication—2d, insalivation—3d, deglutition—4th, chymification—5th, chylification—6th, fœcification—and, 7, defœcation.

Under the second arrangement, the digestive apparatus may be more simply subdivided into two grand parts—1st, The alimentary canal, a musculo-membranous tube, that extends from the mouth to the anus; and, secondly, The glandular organs of digestion, or glands that are intimately connected with the digestive tube.

The alimentary tube consists of four tunics: 1st, an *internal, mucous*, or *villous;* 2d, a *tunica propria*, spread like a framework upon the outer surface of the former; 3d, a *muscular*, exterior to the tunica propria; and, 4th, a *serous* or *external*, formed by the peritoneum, and consequently confined to the abdominal portion of the canal.

1. *The Alimentary Canal, or Musculo-membranous Organs of Digestion.*

Although these organs form a continuous canal, yet each of them may be conveniently viewed as insulated, and in succession examined, commencing at the upper part of the tube, and proceeding downwards, as in the following order: 1st, The Mouth—2d, The Pharynx—3d, The Œsophagus—4th, The Stomach—5th, The small Intestines—6th, The large Intestines—7th, The Anus.

1. *The Mouth. Boundaries: anteriorly* formed by the lips, between which is the ANTERIOR *aperture* of the mouth; *posteriorly*, by the velum palati, betwixt the root of the tongue, and

inferior margin of which is the POSTERIOR *aperture* of the mouth; *superiorly* by the palate; *inferiorly* by the tongue, and *laterally* by the cheeks. Besides attending to the *boundaries* and *structure* of these walls, the student must observe the arrangement and structure of the *teeth*, and the relationships of the gums, both to the teeth and jaws. The teeth are 16 in each jaw, and may be thus arranged:—incisores, $\frac{4}{4}$, canini, $\frac{2}{2}$, bicuspidati, $\frac{4}{4}$, molares, $\frac{6}{6}$. The student has also to note in each tooth the *crown*, the *neck*, and the *root;* and by sawing the tooth in the longitudinal direction, to discover its *internal cavity* and *membrane*, and to observe the relationship between the *enamel* that covers the *crown* and the osseous or ivory part that constitutes the greatest part of the tooth.

2. *The Pharynx.* An irregular funnel-like portion of the alimentary tube, that stretches from the base of the scull to the lower margin of the cricoid cartilage, communicating anteriorly with the nostrils, Eustachian tubes, mouth, and larynx, and inferiorly continued into the œsophagus. *Structure:* consisting, 1st, of muscles (see page 60); 2d, ramifying textures; 3d, cellular membrane; 4th, mucous membrane: 5th, follicles.

3. *Œsophagus.* That part of the alimentary tube that stretches from the pharynx to the superior opening of the stomach, and consisting of a cervical portion, and thoracic portion. *Structure.* 1st, muscular fibres—2d, proper tunic—3d, mucous membrane—4th, œsophageal glands, or follicles—5th, ramifying textures. *Use of the œsophagus.* To conduct the food into the stomach.

4. *The Stomach.* A conical bag, bent from below upwards, and slightly from before backwards; continuous above, with the œsophagus, and below with the commencement of the small intestines, and tapering in that direction,—presenting an anterior surface, a posterior surface, a great curvature, a small curvature, a splenic extremity, an œsophageal or cardiac orifice, and an intestinal or pyloric orifice. *Structure:* 1st, serous tunic—2d, muscular tunic—3d, proper tunic—4th, mucous membrane—5th, cellular substance—6th, *arteries*, from the three branches of the cœliac axis—7th, *veins*, arranged similarly to the arteries—8th, lymphatics—9th, mucous follicles. *Use.* The organ in which the food is converted into *chyme.*

5. *The Small Intestines* commence at the stomach, and terminate at the right iliac region in the cœcum. Usually divided into three portions—1st, duodenum—2d, jejunum—3d, ileon. *Structure.* 1st, *Peritoneal* covering,—2d, *muscular coat* —3d, *proper tunic*—4th, *internal tunic*, presenting numerous circular folds, called valvulæ conniventes, which project for two or three lines into the alimentary tube—5th, follicles of Lieberkhün—6th, glandulæ solitariæ, or Brunner's

glands, found in greatest numbers on upper part of small intestines, and forming a layer near the pylorus, similar in structure to the pancreas.—7th, sacculi solitarii, frequently confounded with Brunner's glands, found in greatest number at the lowest part of the small, and upper part of the great intestines—8th, *sacculi* agminati, usually called glandulæ agminatæ, or glands of Peyer, found in oval patches in the small intestines, but though filled with mucous, presenting no orifice—9th, *arteries*, branches of hepatic, but chiefly of superior mesenteric—*veins*, branches of superior mesenteric, *Lymphatics*, or lacteals—*nerves*, from the solar plexus—cellular membrane.

The Duodenum. That portion of the alimentary tube that extends from the stomach to the commencement of the mesentery, about twelve inches in length, and from the tortuous course it takes, susceptible of a threefold subdivision—1st, the superior transverse portion—2d, the vertical portion—3d, the inferior transverse portion.

Jejunum and *Ileon* are names given to that portion of the small intestines attached to the free margin of the mesentery, continuous above with the *duodenum*, and inferiorly opening into the side of the *cæcum*. This portion, folded frequently upon itself, and in various directions, forms the *convolutions* of the intestines. The upper part, or Jejunum, is not separated from the Ileon by any line of demarcation. The division is entirely arbitrary—the two upper fifths being usually assigned to the Jejunum, and the three remaining fifths to the Ilion. *Structure.* 1st, serous tunic—2d, muscular tunic—3d, internal mucous membrane, and valvulæ conniventes, which last become smaller and less numerous as we trace the intestine downwards.

6. *The Large Intestines.* That portion of the digestive tube which commences in the right iliac region, and after ascending on the right side of the abdomen to the liver, stretches across below the stomach to the left side; it then descends upon that side to the left iliac region; enters the pelvis, and courses along the anterior surface of the sacrum to the anus. Threefold division:—1st, cæcum—2d, colon—3d, rectum. *Cæcum. A cul de sac*, which forms the commencement of the great intestine, into the side in which the ileon enters. *External surface:* marked by three longitudinal bands—by the processus vermiformis, and by elevations and depressions. *Internal surface:* 1st, cells—2d, orifice of the small intestine—3d, orifice of the vermiform process—4th, ileo-cæcal valve. *Structure.* 1st, peritoneal coat—2d, muscular tunic—3d, mucous membrane—4th, mucous follicles—5th, cellular membrane—6th, arteries—7th, veins—8th, lymphatics—9th, nerves.

Colon. That part of the great intestine that stretches from the cæcum to the rectum. From its peculiar course it forms an irregular arch, the convexity of which is in contact with the stomach, and the extremities respectively in the right and left iliac fossæ. *Division.* 1st, ascending or right portion—2d, transverse portion—3d, descending or left portion. *Flexures.* 1st, hepatic—2d, splenic—3d, sigmoid—*External surface.* Longitudinal bands—Elevations and depressions—Appendiculæ epiploicæ. *Internal surface.* Cells. *Structure.* 1st, peritoneal coat —2d, muscular tunic—3d, *proper tunic*—4th, mucous membrane and follicles—5th, cellular membrane—6th, arteries: veins: lymphatics: nerves.

Rectum. Situation. Difference of relation in the two sexes. *External surface* partly covered by peritoneum. *Internal surface:*—Longitudinal wrinkles, called *columns of the rectum. Superiorly* continuous with the sigmoid flexure of the colon. *Inferiorly* contracted, and presenting a round plicate orifice, called the *anus. Structure.* First peritoneal covering—2d, muscular fibres—3d, tunica propria—4th, mucous membrane—5th, mucous follicles—6th, cellular membrane—7th, arteries, veins, lymphatic nerves.

2. *Glandular Organs of Digestion.*

Some of these glandular bodies secrete fluids obviously for lubricating the mucous membrane of the alimentary tube, others elaborate fluids more immediately concerned in the process of digestion, and *one* is a non-secreting body, a vascular ganglion, the use of which, however, is not known.

Anatomical Arrangement: 1st, those connected with the *Mouth*—2d, with the Pharynx—3d, with the Œsophagus—4th, with the *Stomach*—5th, with the Small Intestines—6th, with the Large Intestines.

1. *Oral Glands*, some of which are *solitary*, and lie immediately behind the mucous membrane as the *labial, buccal, lingual, anterior palatine:* others are *clustered* in distinct situations, and covered by the mucous membrane of the mouth as the *amygdalæ* or *tonsils*, which lie between the arches of the palate and the *uvular*, which form the greatest part of the uvula; others as the *salivary*, comprehending the *parotid, submaxillary*, and *sublingual*, are situated exterior to the mouth, but transmit the *Saliva* into that cavity by their excretory canals.

PAROTID GLAND.

Situation. Before the ear and upon the masseter muscle, stretching from the zigomatic process of the temporal bone to the angle of the jaw, and sinking deep between the ascending plate of the jaw-bone and mastoid process of the temporal bone.

Structure. Consists of numerous granulations that are supplied by branches of the temporal artery—with corresponding veins, lymphatics, and nerves. Each granulation transmits a small excretory duct which unites with others of a similar kind, till the large duct (parotid duct) is formed that issues from the anterior margin of the gland—extends to the cheek, pierces the buccinator muscle, and opens in the mouth.

The student should particularly note the relations of this gland to the ear, to the temporal artery and facial nerve that lie imbedded in its substance and in its deepest seated part, to the external and internal carotid arteries and internal jugular vein.

SUB-MAXILLARY GLAND.

Situation. Behind the body of the lower jaw, between the two bellies of the digastric muscle, and covered by the skin and platysma myoides.

Structure. Similar to the parotid. The duct of this gland, which is thin transparent and elastic, proceeds inwards and forwards between the genio-hyoglossus muscle and sublingual gland to the side of the frenum linguæ, when it terminates in a narrow aperture.

The student should attend to the relationship of this gland—to the facial artery, to the inferior and superior surfaces of the mylo-hyoid muscle, and to the jaw-bone.

SUBLINGUAL GLAND.

Situation. Behind the anterior part of the lower jaw, and in the thickness of the lower wall of the mouth.

Structure. Similar to the other salivary glands, and pours its fluid into the mouth by numerous slender tubes that open, some of them in the duct of the sub-maxillary gland, others at the floor of the mouth, and others near the frenum linguæ.

By evaporating the *Saliva*, Tiedemann and Gmelin obtained a solid residue, 100 parts of which gave—

A substance soluble in alcohol, insoluble in water, (fat containing phosphorus)	31·25
Matters soluble both in alcohol and water, (osmazome, chloride of potassium, lactate of potash, and sulpho-cyanuret of potassium)	
Animal matter soluble in boiling alcohol, but precipitated during cooling, with sulphate of potash, and some chloride of potassium	1·25
Matters soluble in water only, (salivary matter, with abundant phosphate and some sulphate of an alkali and chloride of potassium)	20·00
Matters soluble neither in water nor in alcohol, (mucus, perhaps some albumen, with alkaline carbonate and phosphate)	40·00
	92·50

According to Mitscherlich, the following are the saline ingredients of saliva :—

Chloride of potassium	0·18 per cent.
Potash (combined with lactic acid)	0·094
Soda	0·624
Lactic acid	
Soda (probably combined with mucus)	0·164
Phosphate of lime	0 017
Silicic earth	0·015

2. *Pharyngeal Glands*, are mucous follicles studded over the posterior surface of the velum, and lateral and posterior walls of the pharynx under its lining membrane.

3. *Œsophageal Glands.* Similar in structure to those of the pharynx, but smaller and less numerous. They lie in the cellular membrane, between the muscular and mucous layers of the œsophagus, and pour their fluids upon the free surface of the mucous membrane, by small, but distinct orifices.

4. *Gastric Glands.* These may be said to be of two kinds, *internal* and *external.* The *first* are very small and regular cell-like follicles, placed side by side throughout the interior of the organ which secrete a mucous fluid; and the *second* consists of a large glandular-like body, *the spleen*, which may be viewed as a vascular ganglion, attached to the left or bulging extremity of the stomach, and to its outer or peritoneal surface, but the uses of it is not known. It may probably modify and better adapt the blood that circulates through it for the secretory action of the liver.

THE SPLEEN.

Situation. Deeply in the left hypochondriac region, between two laminæ of peritoneum. *Form.* Somewhat oval, smooth, and convex, externally and irregularly concave towards the stomach. *Structure.* Exceedingly soft, spongy, and vascular, and consisting of the following textures—1st, the splenic artery—2d, the splenic vein—3d, lymphatics—4th, nerves from solar plexus—5th, corpuscles measuring about the one-fourth of a line in diameter, and of a greyish-white colour—6th, cellular membrane connecting the above mentioned textures—7th, fibrous covering, which sends numerous prolongations inwards to support the pulpy red tissue of the organ—8th, peritoneal envelope.

5. *Duodenal Glands,* of two kinds, the *internal* and *external.* The *internal* consist of the follicles of Lieberkhün and the glands of Brunner, or numerous flattened follicles, which open upon the free surface of the mucous membrane. The *external* are the glands that secrete the bile and pancreatic fluids, and pour them into the duodenum; these are the *liver* and *pancreas.*

THE LIVER.

Situation. Right hypochondriac region, which it completely fills, and part of the epigastric. *Form.* Irregularly circular—elongated from side to side—thick posteriorly, and thin anteriorly. *Superior surface.* Convex and smooth, corresponding to the concavity of the diaphragm with which it is in contact, divided into two unequal parts by the suspensary ligament. *Inferior surface.* Concave and irregular, presenting depressions and eminences. *Depressions.* 1st, *longitudinal or horizontal groove*, lodging *anteriorly* in the *fœtus*, the umbilical vein, and *posteriorly* the ductus venosus, and in the *adult* the *remains* of these vessels—2d, *transverse groove*, which gives *entrance* to the vena portæ, the hepatic artery, the hepatic nerves, and *exit* to the principal lymphatic vessels and the hepatic duct—3d, *groove* for the *gall-bladder*—4th, *groove* for the *vena cava. Eminences.* The longitudinal groove divides the liver into a *right* and *left lobe*, and the transverse fissure assists in forming an *anterior* and *posterior portal eminence*, the posterior called the *lobulus Spigelii*, and the anterior the *lobulus anonymus. Circumference:—Anteriorly* thin and free; *laterally* connected to the diaphragm by the lateral ligaments, and *posteriorly* attached by condensed cellular substance to the cordiform tendon of the diaphragm; the reflection of the peritoneum from that attachment constitutes the *coronary* ligament. *Structure.* 1st, *ramifying textures* which are more diversified in the liver than in any other organ; consisting of branches of the hepatic artery, of the vena portæ and hepatic vein, of lymphatics, of nerves from the sympathetic, pneumo-gastric and diaphragmatic, and biliary ducts. 2d, *lobules,* or acini. Little rounded bodies of the size of a millet seed, particularly connected, and so numerous as to constitute apparently the fundamental part or parenchyma of the organ. Each *lobule* may be viewed as consisting of the following arrangement of parts—1st, branches of the hepatic duct, that form, according to Keirnan, a plexus; and, according to Müller, an agglomeration of cœcal tubes connected by cellular membranes—2d, branches of the vena portæ and hepatic artery that form another plexus by anastomosing with each other, and surrounding and ramifying upon the biliary plexus or cœcal tubes—3d, a branch of the hepatic vein that commences in the *interior* of the lobule, and called *intra-lobular* vein, which returns the blood from the capillary net-work of the lobule. The intra-lobular vein passes out by the *base* of the lobule under the name of the *sub-lobular vein.* These branches must not be confounded by the student with *inter-lobular* veins, branches of the vena portæ, each of which, with accompanying branches of the hepatic artery, biliary ducts, and hepatic nerves, are—unlike the hepatic vein—surrounded by cellular membrane, a prolongation of the capsule of Glisson, which not only conducts all these textures to and from the liver, but also covers and connects still farther the lobules, and forms the subserous investing membrane for the whole liver.

3d, *Subserous envelope.* A *cellular* membrane, which surrounds completely the liver, and dips into its interior, and covers and connects all the lobules: where it surrounds the vessels at the transverse fissure, it is called the Capsule of Glisson.

4th, *Peritoneal Covering.*—Reflected from the inferior surface of the diaphragm, covering the greater part of the liver, and sending off prolongations which form what are usually called the *ligaments* of the organ.

Excreting apparatus of the Bile.—1st, *the hepatic duct*, formed by the union of exceedingly small biliary ducts, that commence in the lobules; leaves the transverse fissure of the liver, descends about an inch, when it is joined by a smaller canal which leads to and from the gall-bladder (ductus cysticus); the hepatic duct, after the junction of the cystic, is continued to the interior of the duodenum, under the name of *ductus communis choledochus. Gall-Bladder. Form.* Conical. *Situation.* Grooved in the inferior part of the liver, and presenting a *fundus*, a neck, and an excreting duct. *Structure of Gall-bladder.* External or serous coat, middle or cellular, and an internal or mucous. *Use of the Gall-bladder.* A reservoir for the bile. *Use of the Liver.* To secrete the bile.

Bile.

Physical properties.—A fluid of a green colour, bitter taste, and unpleasant odour.

Chemical properties.—According to Thenard, 1000 parts of the bile of the ox contains:—

Water	876·6
Biliary resin	30·0
Picromel	75·4
Yellow colouring matter	5·0
Soda	5·0
Phosphate of Soda	2·5
Chloride of sodium	4·0
Sulphate of soda	1·0
Sulphate of lime	1·5
A trace of oxide of iron	
	1000·0

The Pancreas.

Situation.—Crosses the vertebral column stretching from the spleen to near the neck of the gall-bladder behind the stomach, and almost surrounded by the three portions of the duodenum. *Form.* Elongated: in the transverse diameter of the abdomen, flattened from before backwards, and thicker and larger at its *right* than *left extremity.* *Structure.* 1st, small granules of a grayish white colour, which unite and form granular lobules similar to those of the salivary glands—these granules and granular lobules are connected by condensed *cellular tissue*, and supplied by arteries, veins, lymphatics and nerves.

Excretory apparatus of the Pancreas. *The pancreatic duct* is formed by numerous radicles, which come from every granule of which the gland is composed. The duct lies nearly in the middle of the gland, extending from left to right, and progressively enlarging till it leave the gland, and enter the duodenum, which it does sometimes singly, and sometimes in common with the ductus communis choledochus.

Pancreatic Secretion.

Physical properties.—A fluid, clear though somewhat opaline, ropy like white of egg in water, and of a slightly saline taste.

Chemical properties.—Long supposed to be similar to those of the saliva, but differing—1st, In the quantity of its solid contents, that of pancreatic juice being double in amount to that of the saliva. 2d, The saliva contains mucus and proper salivary matter, with perhaps very minute quantities of albumen and caseous matter; whereas, in the pancreatic juice, the proportions of these principles is reversed—the two latter existing in great abundance, and the former in very minute quantity. 3d, The saliva is alkaline, the pancreatic juice acid. 4th, There is no sulpho-cyanate in the pancreatic juice of the sheep, although it exists in the saliva of that animal. 5th, The *saline* matters are nearly similar in both.

6. *Jejunal and Ilial Glands.*—1st, The follicles of Lieberkhün. 2d, Peyer's glands—numerous round little bodies, some of which are *single*, and others in *oval patches*, which can be discovered often without removing the mucous membrane. They are more numerous in the ileon than the jejunum, and particularly numerous about the junction of ileon and cœcum; but their *structure* and *use* are not yet ascertained.

The latest observations would lead to the conclusions that they are vesicles containing a mucous fluid, and as they present no aperture, the fluid may pass into the intestine by transudation.

7. *Cœcal, Colic, and Hæmorrhoidal Glands.* Of two kinds, the follicles of Boehm, occupying nearly the whole extent of the great intestines and the larger solitary glands, which pour their fluids upon the free surface of the contiguous mucous mem-

brane. In the *colon* these *follicles* are not so numerous as in the cœcum. In the rectum they are arranged as in the cœcum and colon; their excretory orifices, however, are more distinct —directed downwards, and those at the verge of the anus, garnished with delicate hairs.

SECRETIONS OF THE STOMACH AND INTESTINES.

Gastric Juice.

Physical properties.—Dr Beaumont describes the secretions of the human stomach to be—a clear transparent fluid without smell, slightly saltish, and very perceptibly acid; its taste resembling that of thin mucilage, slightly acidulated with muriatic acid. It is readily diffusible in water, wine, or spirits, and effervesces slightly with alkalies; precipitates albumen; undergoes putrefaction with difficulty, and checks its progress in other animal substances.

Chemical properties.—According to Professor Druglison, it contains muriatic and acetic acids in their free state; phosphates and muriates of potass, soda, magnesia, and lime; and an animal matter which is soluble in cold, but insoluble in hot water.

The solvent power of the gastric fluid is generally attributed to the acid it contains, although it is probable that depends upon a peculiar substance or principle, lately denominated *pepsin*, but not yet discovered in an insulated state.

Intestinal Secretion.

In the upper half of the intestines of the dog and horse, Tiedemann and Gmelin found the secretion to consist of—

1st, Some free acid—lower down the secretion was neutral. 2d, Albumen in considerable quantity. 3d, A matter similar to casein. 4th, A matter which is reddened by chlorine or oxymuriate of mercury. 5th, A small quantity of biliary resin. 6th, The usual salts of the animal fluids. 7th, The cœcum of herbivorous animals, according to Schultz, always containing acid during digestion.

Peritoneum.

A serous membrane forming a shut sac, that, generally speaking, invests the viscera of the abdomen, and lines the abdominal parietes. Besides bearing the general relationship thus stated, it forms certain *accessory processes*, which either permit greater dilation or mobility of the immediately contiguous viscera. They are the following:—1st, *gastro-colic omentum*, that apron-like prolongation that stretches from the great curvature of the stomach and from the colon, over part of the small intestines—2d, *gastro-hepatic omentum*, or connecting membrane of the stomach and liver; stretches between the small curvature of the stomach and transverse fissure of the liver—3d, *mesentery*, or that which connects the jejunum and ileon to the spine—4th, *meso-colon*, that portion of the peritoneum that connects the transverse portion of the colon to the spine—5th, *meso-rectum:* that process of the serous membrane that connects the upper part of the rectum to the sacrum—6th, *Posterior Ligaments of the Bladder.*—That reflection of peritoneum, between the posterior surface of the bladder, and anterior surface of the rectum in the male, or anterior surface of the vagina and uterus in the female. In the female also the broad ligaments of the womb may be considered as *processes*, which connect the womb to the lateral parts of the pelvis—7th, *Meso-cæcum.*—A process connecting the cæcum to the iliac fossa—8th, *Left Iliac Meso-colon.*—This process is of considerable extent, and attaches the sigmoid flexure of the colon to the left iliac region.

In tracing the reflections of the peritoneum, the student should observe the *foramen of Winslow*—an oval opening near the capsule of Glisson, that leads into a cavity between the lammæ of the omentum majus and minus.

PART V.

THE LYMPHATIC OR ABSORBENT SYSTEM.

The apparatus by which *absorption* is effected, consists of —1st, Lacteals—2d, Lymphatic vessels—3d, Lymphatic ganglia, or conglobate glands—and 4th, The thoracic duct.

I.—LACTEAL VESSELS.

1st, *Origin of the Lacteals.*

The lacteals unquestionably arise in the villi of the mucous tunic of the intestine, but the manner in which they originate has not yet been ascertained.

2d, *Course of the Lacteals.*

The lacteal vessels extend from the inner surface of the intestines to the thoracic duct, and traverse in succession—1st, The valvulæ conniventes from their free to their adherent margins—2d, The muscular fibres of the intestine—and 3d, The mesentery.

Little information can be obtained regarding the course and arrangement of these vessels to the *valvular* and *muscular* divisions of their course. From the time they leave the muscular fibre, their course is better known. The vessels may be seen in this part of the course—1st, Under the peritoneal coat of the intestine running in a zig-zag or angular manner, till they reach the mesentery—they then pass betwixt *the layers* of the mesentery, and through the mesenteric glands or ganglia, of which some are situated close by the intestine—others larger and aggregated are near the root of the mesentery, and consequently nearer the thoracic duct.

The *use* of the lacteals is undoubtedly to absorb chyle ; and some physiologists, with Magendie, contend that they absorb nothing else.

II.—LYMPHATIC VESSELS.

Lymphatic Vessels are so denominated, because they are usually found to contain a pellucid or watery-like fluid—*the* *lymph.* They strikingly resemble the lacteals, which are only indeed a part of the absorbent system. The *origin* of the lymphatics is involved in even greater obscurity than that of the lacteals. If they do not arise from every organic molcule of the body, which indeed is extremely probable that they do, they are undoubtedly to be found commencing in every free surface, or where a moisture is effused. According to this last view, they would arise from the whole external surface of the body—from the cells of the cellular texture—from the interior of all the serous and synovial membranes—from all the mucous surfaces—from the interior of arteries and veins, and ducts of excreting organs. From the resemblance which the lymphatics bear to the lacteals, it is extremely probable that they originate in a similar manner, although experiments and observations do not lead us to any decided conclusion.

Structure of Lymphatics.

These slender and pellucid vessels are formed of two tunics—1st, The external, which consists of condensed cellular texture; 2d, The internal or serous-like tunic, which lines the former, polishes its inner surface, and is prolonged internally to form *valves.* These valves are very numerous, and arranged in pairs, and so disposed as to offer no obstruction to the lymph in its transit to the heart, but, like flood-gates, are thrown across the vessel to oppose any retrogradation of the same fluid. The tunics of the lymphatics, pellucid though they be, are remarkably strong: they can support a heavier column of mercury than either arteries or veins.

Course of the Lymphatics.

The lymphatics may be said generally to take the course o the veins, and thus may be arranged into two divisions—1st, The superficial or subcutaneous; and 2d, The deep-seated. The first forms a net-work nearer the skin, that encircles the limbs and all the other parts of the body: and the second is found coursing along the deep-seated arteries and veins.

All the lymphatic vessels traverse conglobated glands or *lymphatic ganglia.* These lymphatic knots or swellings vary in form and size, and are clustered generally in determinate localities, as in the groins and axillæ, but scattered also over many parts of the body. We find the vessels—1st, *entering* the ganglia—2d, *passing through* the ganglia—and 3d, issuing out of the opposite extremities of the ganglia. The first—the *vasa inferentia*—enter the *distal* extremity of the ganglion, and consequently convey lymph to the organ. In the ganglia the vessels either become much convoluted, and pass thus continuously through, or terminate in cells into which the lymph is poured, and thence absorbed by the *vasa efferentia.*

These vessels may be arranged—1st, Into those that terminate in the thoracic duct—2d, those that terminate in some great vein—and 3d, those that partly terminate in the thoracic duct, and in some great vein.

[The following is an Arrangement of these Vessels, with a short reference to their Course and Gangliar Connexions.]

LYMPHATICS THAT TERMINATE IN THE THORACIC DUCT.

1. *Lymphatics of the Lower Extremities.*

1st, *Superficial* lymphatics of the *lower extremity* ascend the leg and thigh, so as to constitute an encircling network, and pass through inguinal, external iliac, and lumbar ganglia.

2. *Deep* lymphatics of the *lower extremity* course along the tibial, poplitcal, and femoral arteries, and pass through the inguinal, external iliac, and lumbar ganglia.

2. *Lymphatics of the Pelvic Viscera and Pelvic Walls.*

Arranged into anterior, middle, and posterior.

1. Lymphatics of the *bladder*, take the course of the vesical vessels, and pass through the hypogastric and lumbar ganglia
2. Lymphatics of the *rectum*, take the course of the hæmorrhoidal arteries, and pass through mesorectal, hypogastric, and lumbar ganglia.
3. Lymphatics of the *uterus*, chiefly ascend along the spermatic vessels, pass through the lumbar ganglia, some of the lower ones unite with those from the *vagina*, and pass through the hypogastric and lumbar ganglia.
4. Lymphatics of the *perineum*, *scrotum*, and *integuments of penis*, and corresponding parts in the female, pass through the inguinal, external iliac, and lumbar ganglia.
5. Lymphatics of the *testicle* ascend the spermatic cord, and pass through the lumbar ganglia.
6. *Deep* lymphatics of the *penis* and *clitoris* follow the course of the pudic artery, and traverse the hypogastric and lumbar ganglia.
7. *Sacral* lymphatics pass through the sacral, hypogastric, and lumbar ganglia.

3. *Lymphatics of the Abdominal Walls and Viscera.*

1. *Superficial* lymphatics of the *loins* and *lower half of the abdominal walls*, descend to Poupart's ligament, and pass through the inguinal, external iliac, and lumbar ganglia.
2. *Deep-seated* lymphatics of the abdominal walls course along the epigastric, circumflexa ilii, and lumbar arteries; the two first pass partly through the external iliac and lumbar ganglia, and the last through the lumbar only.

3. Lymphatics of the *stomach* course along the small and great curvatures of the organ, and pass partly through the splenic, partly through the gastro-epiploic, and partly through the gastro-hepatic ganglia.

4. Lymphatics of the *small intestines* (lacteals) lie betwixt the layers of the mesentery, and pass through the mesenteric glands.

5. Lymphatics of the *great intestines* lie betwixt the layers of the meso-colon, and pass through the meso-colic ganglia.

6. Lymphatics of the *liver* pass principally through the hepatic, some through the gastro-hepatic ganglia.

7. Lymphatics of the *spleen* pass through the splenic ganglia.

8. Lymphatics of the *pancreas* pass through the pancreatic ganglea.

9. Lymphatics of the kidney pass through the lumbar ganglia.

10. Lymphatics of the *renal capsule* on the right side traverse the hepatic ganglia, and on the left the splenic.

11. *Intercostal* lymphatics pass through the intercostal ganglia.

LYMPHATICS THAT TERMINATE IN THE RIGHT SUBCLAVIAN VEIN.

1. *Lymphatics of the Right Superior Extremity.*

1. *Superficial* lymphatics. Some follow the course of the subcutaneous veins, and pass through the brachial and axillary ganglia.

2. *Deep-seated* lymphatics course along the principal arteries of the extremity, and traverse the axillary ganglia.

2. *Lymphatics of the Right side of the Head and Neck.*

1. Lymphatics of the *posterior region of the neck* descend to the posterior border of the axilla, and pass through the axillary ganglia.

2. *Superficial* lymphatics of the *head* and *anterior part of the neck*, take the course of the external jugular vein, and pass through the superficial cervical ganglia.

3. *Deep-seated* lymphatics of the *anterior part of the neck.* No lymphatic vessels have yet been discovered in the brain; those of the deep-seated parts of the face and neck traverse the glandulæ concatenatæ.

4. *Deep* lymphatics of the *right side of the thorax* pass through the axillary ganglia.

LYMPHATICS THAT TERMINATE PARTLY IN THE THORACIC DUCT, AND PARTLY IN THE LEFT SUBCLAVIAN VEIN.

1. Lymphatics of the *left* superior extremity.
2. Lymphatics of the *left* side of the head and neck.
3. Superficial lymphatics of the *left* side of the thorax.

The above lymphatics take the same course, and traverse the corresponding ganglia with those of the right side.

4. *Lymphatics of the Thoracic Viscera.*

1. Lymphatics of the *lungs* pass through the bronchial glands, and terminate partly in the great thoracic branch of the *right* side, and partly in the thoracic duct.
2. Deep-seated *sternal* lymphatics arise from the upper hal of the abdomen, pass into the thorax behind the xiphoid appendage, and traverse the substernal ganglia.
3. Lymphatics of the *diaphragm* traverse the mediastinal and substernal ganglia.
4. Lymphatics of the *heart* pass through the substernal ganglia, and terminate partly in the thoracic duct, and partly in the left jugular or subclavian vein.
5. Lymphatics of the Œsophagus traverse the mediastinal ganglia.

III.—LYMPHATIC GANGLIA.

1. *Ganglia of the Head and Neck.*

1st, Posterior aural—2d, parotideal—3d, buccal—4th, superficial cervical—5th, deep-seated cervical, or glandulæ concatenatæ.

2. *Ganglia of the Thorax.*

1st, Mediastinal—2d, bronchial—3d, intercostal—4th, substernal.

3. *Ganglia of the Superior Extremity.*

1st, Brachial—2d, axillary.

4. *Ganglia of the Inferior Extremity.*

1st, Anterior tibial—2d, popliteal—3d, inguinal.

5. *Ganglia of the Pelvis.*

1st, External iliac—2d, hypogastric—3d, sacral—4th, mesorectal.

6. *Ganglia of the Abdomen.*

1st, Lumbar—2d, mesenteric—3d, meso-colic—4th, gastro-epiploic—5th, gastro-hepatic—6th, hepatic—7th, pancreatic—8th, splenic.

IV.—THORACIC DUCT.

Situation.—In the thorax, and for a considerable part of its course between the vena azygos and aorta. *Course.* It commences upon the body of the second lumbar vertebra, forming an enlargement called *receptaculum chyli*, passes into the thorax by the aortic opening of the diaphragm, ascends upon the anterior surface of the vertebral column, as far as the neck, and opens into the junction of the jugular and subclavian vein of the left side.

Termination of Lymphatics.

The greatest part of the lymphatics terminate in the *thoracic duct.* Some terminate directly in the right subclavian vein. Other communications have been observed as between the thoracic duct and lumbar, and various other veins.

Use of Lymphatics.

The arguments that tend to prove the absorbing power of the lymphatics, are—1st, Those drawn from analogy—and 2d, Those from observation.

The lymphatics are admitted to be a part of the same system of vessels with the lacteal, and to be similar to them in form, size, and structure. Many of them anastomose with the lacteals, and almost all unite with them in the thoracic duct.

In poisoned wounds, as from dissection the inflamed vessels are uniformly *lymphatics.*

Lymphatics have been seen in the act of removing different fluids; and unless such fluids were generated in the vessels themselves, absorption must have been effected.

Lymph.

Physical Properties.—A transparent pale yellow fluid, destitute of smell, slightly alkaline, and containing a number of colourless globules, which are smaller and fewer than the red particles of the blood; like blood, it separates when taken from the body, into a coagulum and serum.

Chemical Properties.—According to Lassaigne, the lymph of the horse consists of—

Water	92·500
Fibrin	0·330
Albumen	5·736
Chlorides of sodium and potassium, with soda and phosphate of lime	1·434
	100·000

Tiedmann and Gmelin state that the lymph contains likewise salivary matter, osmazome, carbonates, sulphates, muriates, and acetates of soda and potash, with phosphate of potash.

Chyle.

Or fluid absorbed from the small intestines by the *lacteals*, differs from the lymph in being of a white or milky colour; it has an alkaline reaction, and a remarkable spermatic odour. It is susceptible of a spontaneous coagulation; the coagulum, consisting of *fibrine* and *globules*, and the serum, according to Gmelin, of the following solid ingredients:—

Albumen	55.25
Osmazome, with acetate of soda, and chloride of sodium (the most abundant saline ingredient), crystallised in octohedrons, probably from containing some animal matter .	16·00
A matter soluble in water and insoluble in alcohol, and resembling salivary extractive matter, with carbonate and a very small quantity of phosphate of soda . . .	2·76
Brown fatty matter	15·47
Yellow fatty matter	6·35
Carbonate and some phosphate of lime obtained by calcination of the albumen	2·76

PART VI.

ORGANS OF THE CIRCULATION OF THE BLOOD.

The organs by which this function is performed are susceptible of three grand subdivisions—1st, the heart or central organ of the circulation—2d, the arteries or tubes by which the blood is carried to every part of the body—and 3d, the veins or tubes that return the blood again to the central organ.

DIVISION I.

THE HEART.

The *heart* is a hollow compound muscular organ, consisting of four cavities, and surrounded by a fibro-serous envelope, the *pericardium.*

Situation. Above the diaphragm, between the laminæ of the mediastinum, towards the left side of the thorax, and placed obliquely, the *apex* turned downwards and forwards to the fifth intercostal space of the left side, and the *base* upwards and to the right side.

Form. Conical or pyramidal, flattened inferiorly, where it rests upon the diaphragm, and rounded and convex anteriorly and superiorly.

It presents, *externally*, *two surfaces*, an anterior and posterior—*two margins*, a right and left—a *base* and an *apex.* The heart should be examined first in *situ*, and the grand divisions of its *external surface* noted, particularly the relative position of the right and left sides of the heart, and the situation of the auricles with respect to the ventricles, and with regard to each other.

The *interior* of the heart is subdivided into *four chambers*—two superior, called *auricles*, and two inferior, or *ventricles.* The *right side* of the heart consists of an auricle and a ventricle—the auricle for receiving the blood from the venæ cavæ, and transmitting it into the ventricle—and the ventricle for forcing the blood it receives from the auricle into the pulmonary artery. The *left side* of the heart consists like the right of an auricle and a ventricle—the auricle for receiving the blood from the pulmonary veins, and transmitting it into the ventricle, and the ventricle for propelling the blood into the aorta and all its ramifications, and consequently into all the textures of the body. These cavities should be opened in succession, and the *internal machinery* exposed and examined. The following points should be noted:—

1. The *right auricle*—its form and size, its communication with the two venæ cavæ, with the coronary vein, and with the right ventricle and its internal processes, viz., the Eustachian valve, the valve of the coronary vein, tuberculum Loweri, fossa ovalis, and musculi pectinati.

2. The *right ventricle*—its form, size, the thickness of its walls, its inlet or right auriculo-ventricular opening—its outlet or orifice of the pulmonary artery, and its internal processes, viz., the triglochin or tricuspid valve, the cordæ tendineæ, columnæ carneæ, sigmoid valves of the pulmonary artery with the corpuscula Aurantii.

3. The *left auricle*—its form, size, communication with the four pulmonary veins, and left ventricle and the internal processes, viz., the musculi pectinati.

4. The *left ventricle*—its form, size, inlet or left auriculo-ventricular opening, outlet or orifice of aorta, and its internal processes, viz., the mitral or bicuspid valve, cordæ tendineæ, carneæ columnæ, sigmoid or aortic valves, with their corpuscula Aurantii.

The *heart* is formed by a combination of the *following textures.*

1st, *Muscular fibres*, so arranged as both to arise from, and be inserted into the fibrous rings that form respectively the mouths of the arteries and the auriculo-ventricular openings—the fibres of the *auricles* forming loops that cross each other in various ways, and are inserted into the auriculo-ventricular opening, and the fibres of the *ventricles* running some of them transversely, and others obliquely downwards. Of these last, some pass around both ventricles, others around the left only—and others and these the most superficial, pass obliquely towards the apex, thence penetrating *into* the ventricles to form the *carneæ columnæ* and other irregularities which the interior surface displays.

2d, *Tendons*—which connect the auriculo-ventricular valves to the *fleshy pillars.*

3d, *Arteries*—the two *coronary*, which supply exclusively the organ.

4th, *Veins*—branches of the *coronary* which pass by a single orifice into the right auricle.

5th, *Lymphatics*, superficial and deep-seated.

6th, *Nerves*, from the cardiac plexus.

These textures are connected together by cellular membrane, and the *internal* cavities of the organ lined by a serous-like membrane, the reduplication of which forms the valves, and its *external surface* covered by a reflection of the serous membrane of the pericardium.

The *motions* and the *sounds* of the heart ought to be investigated with great care by the student. He should endeavour to *see* the heart in *action* in some inferior animal—to observe its *contractions*, *dilatations*, and *impulse* upon the thoracic walls—to become acquainted with the sounds emitted during its action—with the *first* or *dull sound* emitted during the contraction of the ventricles—with the *second* or *clear sound* emitted during the dilatation of the ventricles, and with the *pause* during the last half of which the auricles perform their *inaudible* contractions.

DIVISION II.—THE ARTERIES.

The term artery means air-tube, and was introduced by the ancients from the supposition that the arterial tubes really contained air while the blood was confined exclusively in the veins. The name artery is still retained, although the opinion upon which it was formed has long ago been exploded. The assemblage of all the arteries of the body forms the arterial system which in two grand divisions commences at the heart. One of these divisions, the *Pulmonic*, emanates from the right ventricle of the heart, and conveys blood into the lungs, for the purification of the sanguineous fluid. The other division, the *Systemic*, arises from the left ventricle, and conveys blood into the various textures of the general system. The systemic division of this system forms a vascular tree, the root of which is implanted in the heart, and the branches spread out and ramify in the various textures of the body. The pulmonic division presents also the arborescent form, the root of which also emanates from the heart, and the branches proceed to the lungs only.

In examining this subject, we shall confine ourselves principally to the systemic division, and attend to—1st, The mode of connection between the heart and aorta. 2d, The form and situation of the principal arterial trunks. 3d, The manner in which the branches leave the trunks. 4th, The anastomoses of these vessels. 5th, Their terminations—and 6th, The structure of the arterial tissue.

1st, *The mode of connection between the Heart and Aorta.*

The aorta is not a prolongation of the fleshy fibres of the heart; the heart and aorta are of different textures and their connection peculiar. Betwixt the aorta and fleshy fibres of the heart, a white fibrous or tendinous-like ring exists, from which fibres of the heart stretch on the one hand, and the aorta arises on the other—the middle coat of the aorta presenting a festooned border with three points connected to the fibrous ring, and the junction strengthened internally by the lining membrane of the heart continued into the aorta, and externally by the serous membrane of the pericardium extending upwards some way before it is reflected from the vessel.

2d, *Form of the Arterial Tubes.*

The arteries were long supposed to be of a conical form. More correct observation has demonstrated, that although they decrease in size as they proceed from the heart, they are rather a series of successively diminishing cylinders than of cones. The whole arterial system, however, is of a conical form, the apex of the cone being situated in the heart, and its base embracing the rest of the body.

The larger arteries are generally confined to deep-seated parts of the body and well protected, or when placed superficially, are capable of being protected by the ordinary movements of the parts over which they pass, as by the bending forward of the head and trunk, and the flexure or doubling up of the different joints.

3d, *The Branching of the Arteries.*

The aorta divides into branches, and these into successively smaller ramifications, till they become capillary. Few branches pass off at right angles from the principal trunk. The angles are generally more or less acute, the salient part of the angle turned uniformly to the heart, and presenting little obstruction to the onward movements of the blood.

4th, *The Arterial Anastomoses.*

Anastomosis is the mutual communication or inosculation of vessels: of this there are two forms—1st, When two equal trunks unite—and 2d, When a large vessel unites with a smaller one. Of the first kind there are three varieties—1st, When two trunks unite so as to form one, as the two vertebral to form the basilary—2d, When two trunks communicate by a *transverse* branch, as the two anterior cerebral—and 3d, When two trunks by mutual union form an arch, as among the branches of the mesenteric arteries. The second mode of inosculation is frequent in the extremities, and they are all calculated to secure a free and uninterrupted circulation of the sanguineous fluid.

5th, *The Termination of Arteries.*

Haller enumerates five terminations of arteries:—

1st, Directly in a red vein or veins.

2d, In excreting ducts, as in the lachrymal or salivary glands.

3d, In exhalants, as in the skin and in the membranes of the various cavities of the body.

4th, In smaller vessels, as the lymphatics.

5th, In the colourless artery—arteria non rubra.

The only *demonstrable* termination of arteries, however, is into veins.

6th, *Structure of the Arterial Tissue.*

By dissection the following textures are exposed:—

1st, The external tunic, consisting of cellular membrane.

2d, The middle fibrous or proper tunic—of a yellowish or greyish colour—of considerable density and elasticity, and consisting of delicate fibres that run transversely, and adhere to each other, but are easily separated. It is intimately connected, externally, with the cellular tunic, and polished off within, by the internal tunic. The fibres of this tunic are different from the muscular, in physical, chemical, and physiological properties: they are elastic, but not irritable, and consequently not muscular.

PULMONARY ARTERY.

Origin. From the right ventricle. *Course.* Obliquely upwards, and to the left side, as far as the descending part of the arch of the aorta, when it divides into two branches—*a right* and a left, the one to ramify upon the right, and the other upon the left lung, and to carry blood to be influenced by the process of respiration.

In studying this part of the arterial system, the student should note the following particulars:—1st, the fibrous ring that exists at the mouth of the pulmonary artery—2d, the *size* of the pulmonary arterial *trunk*, and its position and attachment to the aorta—3d, its division into two branches, and its connection with the descending part of the arch of the aorta, by the *remains* of the *ductus arteriosus*—4th, the course and relative position of its right and of its left branches—and, 5th, the distribution and termination of these branches upon the air-cells of the lungs.

THE AORTA AND ITS RAMIFICATIONS.

The *systemic* division of the arterial system may be viewed as consisting of, 1st, the aorta, or systemic arterial vessel—2d, the branches that proceed *directly* or primarily from that great arterial trunk—and, 3d, the more minute or *secondary* branches—those that proceed directly from the primary, and which, after numerous subdivisions, terminate in the various textures of the body.

Or we may view the aorta as susceptible of a threefold division—*an arch*—a *descending* portion—and an *abdominal* portion, and each supplying a determinate part of the body: the *arch* furnishing branches for the head, neck, and superior extremities: the descending thoracic aorta for the thoracic walls, and thoracic viscera: and the abdominal aorta for the abdominal walls—abdominal and pelvic viscera, and inferior extremities.

In the following description of the arteries, we have adopted this last arrangement, and viewed the aorta as consisting of, 1st, an arch—2d, a descending thoracic aorta—and, 3d, an abdominal aorta, and have shortly adverted to the primary and secondary branches, in each subdivision.

I.—THE ARCH OF THE AORTA

Commences at the base of the left ventricle, and stretches obliquely across the thorax to the left side of the body of the third dorsal vertebra, where it is continued into the descending thoracic aorta. It presents *four aspects*—an anterior, a posterior, a superior, and an inferior; and *two extremities*—an anterior, arising from the heart, and a posterior, in contact with the third dorsal vertebra, the relationships of all which must be particularly noted.

The arch consists of three parts—*an ascending*, a *transverse*, and a *descending portion*: from the *first*, the coronary arteries of the heart arise; from the *second*, the arteria innominata, or brachio-cephalic, left carotid and left subclavian; and from the *third* no artery arises, but near the upper extremity of this division the *remains* of the ductus anteriosus is inserted.

Arteries that arise from the ascending portion of the Aorta.

1st, *Arteria Coronaria Anterior.—Origin.* The root of the aorta immediately above the free edge of the posterior aortic valve. *Course.* After a tortuous course, it gains the groove betwixt the two ventricles on the anterior aspect of the heart, and extends to the apex of the organ. *Branches:* 1st, superior—2d, posterior—3d, inferior.

2. *Arteria Coronaria Posterior.—Origin.* The root of the aorta above the interior aortic valve. It ultimately reaches the groove on the posterior or flat surface of the heart, extending to the apex. *Branches:* 1st, superior—2d inferior.

Arteries that arise from the transverse portion of the Arch.

1st, Arteria innominata, or brachio-cephalica—2d, carotica sinistra—3d, subclavia sinistra.

1. *Arteria Innominata, or Brachio-cephalica.*

Origin. Top of the arch. *Course.* Obliquely upwards, and to the right side, for the space of an inch, when it divides into the right carotid and right subclavian. It is covered anteriorly by the upper piece of the sternum, by the sterno-hyoid and sterno-thyroid muscles, and left vena innominata, and bounded posteriorly by the trachea and longus colli muscle. *Branches:* sometimes the *middle thyroid* arises from it, and ascending on the front of the trachea, is lost on the thyroid gland.

Arteria Carotica Communis (Dextra and Sinistra).

Origin. From the arteria innominata on the right side, and upper part of the arch of the aorta on the left. *Course.* Obliquely upwards and outwards to the superior margin of the thyroid cartilage, where they divide into the external and internal carotids. *Relative situation.* The *thoracic portion* of the left carotid, extends from its origin to the left sterno-clavicular articulation, and is covered anteriorly by the sternum, remains of thymus body and left vena innominata, and bounded internally, and somewhat posteriorly, by the trachea, œsophagus and thoracic duct. The *cervical* portions of both common carotids are nearly alike—*deep-seated between* the sternum and cricoid cartilage, and covered by skin, platysma myoides, fascia, sterno-hyoid, sterno-thyroid, and omo-hyoid muscles: and more *superficially* above the cricoid cartilage, being covered only by the skin, platysma myoides and fascia of the neck. *Posteriorly* the artery is bounded by the longus colli, rectus capitis anticus major muscles, inferior thyroid artery, and great sympathetic nerve. *Internally* by the trachea, the thyroid gland, and larynx; and *externally* by the pneumo-gastric nerve, and internal jugular vein. When the artery is exposed, and its sheath opened, it is found accompanied by the internal jugular vein, with tho pneumo-gastric nerve between them; the descending branch of the hypoglossal nerve lying anteriorly, and the great sympathetic nerve behind.

Arteria Carotica Externa.

Origin.—Upper extremity of the common carotid artery, opposite the superior margin of the thyroid cartilage. *Course.* Extends from its origin, to the neck of the condyle of the lower jaw, where it divides into the temporal and internal maxillary branches. *Relative situation. Inferiorly* in the neck, less deep than *superiorly. Below the os hyoides*, covered by the skin platysma myoides, fascia, and some veins—*opposite the os hyoides* it is farther covered by the digastricus and stylo-hyoideus muscles, and crossed by the hypoglossal nerve, and above the digastricus it penetrates the parotid gland, and is there crossed by the portio dura, or fascial nerve.

Posteriorly, the artery is in contact with the following parts, enumerating them from below;—The superior laryngeal nerve, the pharyngeal plexus, the stylo-pharyngeus, and stylo-glossus muscles, glosso-pharyngeal nerve, and a portion of the parotid gland.

Branches: 1st, thyroidea superior—2d, lingualis—3d, facialis—4th, pharyngea ascendens—5th, occipitalis—6th, posterior auris—7th, temporalis—8th, maxillaris interna.

These branches may be still farther usefully arranged into the anterior, the posterior, the internal, and terminal. The *anterior* includes the superior thyroid, the lingual and the facial—the *posterior*, the posterior auris and occipital—the *internal*, the ascending pharyngeal, and the *terminal*, the temporal and internal maxillary.

1. *Ar. Thyroidea Superior.—Origin.* Anterior aspect of external carotid near the horn of the os hyoides. *Course.* First upwards and inwards, and forming an arch, soon turns downwards and continues along the side of the larynx as far as the thyroid gland. In this course it transmits branches to the muscles about the os hyoides, to the sterno-mastoid muscle, and in particular to the larynx and thyroid gland.

2. *Ar. Lingualis.—Origin.* Anterior aspect of external carotid, a little above the origin of the former artery. *Course.* Stretches forwards and inwards along the upper part of the great horn of the os hyoides to the base of the tongue, and is continued along its inferior surface to the apex of the organ. It transmits branches to the muscles about the os hyoides, to the dorsal aspect of the tongue, to the sublingual gland, and to the muscles of the tongue generally.

3. *Ar. Facialis.—Origin.* Anterior aspect of external carotid above the lingual and behind the digastricus muscle. *Course.* Upwards and forwards to the base of the lower jaw, which the

artery clears at the anterior margin of the masseter muscle—then extending upwards and forwards upon the face near the angle of the mouth and side of the nose, reaches the inner canthus of the eye. In the *neck* the artery sends off branches to the palate, to the tonsils, to the submaxillary gland, and to the muscles under and about the chin, and in the *face* to the cheek, lower lip, upper lip, nose, and angle of the eye.

4. *Ar. Occipitalis.—Origin.* Posterior aspect of external carotid at the lower margin of the digastricus muscle. *Course.* It runs deep-seatedly upwards and backwards to the groove betwixt the transverse process of the atlas and mastoid process of the temporal bone—then running horizontally backwards behind the *long* occipital muscles, it pierces the trapezius and spreads upon the occiput. In this course it sends off branches to the following parts—to the glands and muscles in the lateral part of the neck, to the dura mater, to the muscles of the back of the neck, and to the integuments of the cranium.

5. *Ar. Posterior Auris.—Origin.* Posterior aspect of external carotid, somewhat higher than the origin of the occipital. *Course.* Upwards and backwards through the substance of the parotid gland to the groove betwixt the anterior part of the mastoid process of the temporal bone and pavilion of the ear, from which it extends upwards to the back of the ear and integuments of the head. In its course this small vessel supplies the following parts—the parotid gland and digastric muscle, the middle ear, the external ear, and integuments of head.

6. *Pharyngea Ascendens or Inferior.—Origin* Posterior aspect of external carotid usually opposite the origin of the lingual. *Course.* Ascends along the vertebral column close by the pharynx as far as the base of the cranium. This very small vessel transmits branches to the following parts—the pharynx, soft palate, Eustachian tube, glands and nerves at the basis of the cranium, and the dura mater.

7. *Ar. Temporalis.—Origin.* Upper extremity of external carotid, opposite the neck of the lower jaw, where it separates from the internal maxillary. *Course.* Ascends through the parotid gland, passes over the root of the zigoma anteriorly to the ear, and branches upon the temples between the skin and temporal aponeurosis. In its course it supplies in succession the following parts—the parotid gland, the face, the temporo-maxillary articulation, the temporal muscle, the anterior aspect of the ear, and the integuments of the cranium.

8. *Ar. Maxillaris Interna.—Origin.* Upper extremity of the external carotid, usually at the neck of the condyle of the lower jaw. *Course.* Obliquely forwards and upwards in a very tortuous manner, between the pterygoiden muscles to the summit of the zigomatic fossa, and sending off branches, some of

which ramify upon the muscles, viz., the pterygoiden muscles; the masseter, the temporal and buccinator; and others enter cranial foramina to supply the lower jaw, and lower lip and teeth, the dura mater, the upper teeth, the floor of the orbit and face, the palate, and the nostril.

Arteria Carotica Interna.

Origin. Upper extremity of the common carotid, usually opposite the superior margin of the thyroid cartilage. *Course.* It extends along the front of the transverse processes of the three superior cervical vertebræ to the base of the cranium, when it enters and winds through the carotid canal and cavernous sinus; and reaching the anterior clynoid process, it sends off its branches that are lost in the substance of the brain. The artery then is susceptible of a fourfold division—1st, a *cervical*—2d, a *cranial*—3d, a *cavernous*—and, 4th, a *cerebral*, all of which have important relations—the first in particular to the pharynx and *tonsil* which lie upon its inner side—the second to the middle and internal parts of the organ of hearing—the third to the 3d, 4th, 5th, and 6th nerves—and the fourth to the brain. *Branches.* 1st, arteriæ receptaculi—2d, ophthalmica—3d, anterior cerebri—4th, media cerebri—5th, communicans posterior.

1. *Ar. Receptaculi.—Origin.* Internal carotid within the cavernous sinus. *Course.* Small twigs that supply branches of the sympathetic nerve, the Gasserian ganglion, and walls of the sinus.

2. *Ar. Ophthalmica.—Origin.* Internal carotid artery at the inner side of the anterior clynoid process of the sphenoid bone. *Course.* A small but remarkable artery that enters the optic foramen, twines round the optic nerve, and extends along the inner wall of the orbit to the nose and destined to supply the eye-ball and its appendages—more particularly it supplies the following parts—the lachrymal gland—the retina—the sclerotic coat, choroid, and iris—the muscles of the eye—the ethmoid cells and mucous membrane of the nostril—the upper and lower eye-lids and conjunctiva—the nose and the forehead.

3. *Ar. Posterior Communicans.—Origin.* Internal carotid at the base of the brain. *Course.* Extends for about an inch backwards and inwards on the external side of the infundibulum, and joins the posterior cerebral, a branch of the basilar near the anterior margin of the nodus cerebri.

4. *Ar. Cerebri Anterior.—Origin.* A terminal branch of the internal carotid artery. *Course.* Forward and inwards to the fissure at the anterior part of the base of the brain—turns round the anterior margin of the corpus callosum, and extends backwards upon the superior surface of this commissure to the

posterior lobe of the brain. The arteries of the opposite sides communicate by a short transverse branch, and supply a part of the anterior, middle, and posterior lobes.

Ar. Media Cerebri.—Origin. The principal terminating branch of the internal carotid artery. *Course.* Along the fissura magna Sylvii, and transmitting branches to the choroid plexus, to the anterior, middle, and posterior lobes of the brain.

ARTERIES OF THE SUPERIOR EXTREMITY.

Arteria Subclavia (Dextra and Sinistra).

Origin. The *right* subclavian from the arteria innominata, and the *left* from the arch of the aorta. *Course.* Upwards and outwards behind the scalenus anticus muscle, to the superior surface of the first rib, at the lower margin of which it becomes the axillary artery.

Relative Situation. This artery is usually divided into three portions, an internal or *tracheal*, a middle or *scalenic*, and an external or *acromial*, each of which has important relations. In the first division the arteries of the opposite sides differ, the left subclavian being longer than the right, also more vertical and more deeply situated.

On the *right side* the tracheal portion of the subclavian runs transversely, and holds the following relations: *anteriorly* covered by the skin, fascia, clavicular portion of the sterno-cleido-mastoid, sterno-hyoid, and sterno-thyroid muscles —jugular and vertebral veins—pneumo-gastric nerve—the anterior filaments of inferior cervical ganglion of the great sympathetic nerve and the phrenic nerve: *posteriorly* in contact with the recurrens laryngis nerve—the great sympathetic nerve and vertebral column.

On the *left side*—the *first division* of the artery, as it ascends from the aorta to the inner margin of the first rib, is covered *anteriorly* by the sternum, first rib and clavicle, by the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles by the jugular vein left vena innominata: by the left carotid artery, pneumo-gastric nerve, by the thoracic duct and the left lung and pleura. *Posteriorly*, it is bounded by the vertebral column, the longus colli muscle, and great sympathetic nerve.

The scalenic and acromial divisions of the artery are alike on both sides.

The *scalenic portion* lies between the scaleni muscles, and *inferiorly* resting partly upon the pleura, and partly upon the middle scalenus muscle, and covered anteriorly by the skin, platysma, sterno-mastoid muscle, fascia, subclavian vein, phrenic nerve, transversalis humeri artery, scalenus anticus muscle

—*posteriorly* bounded by the scalenus medius muscle, and *superiorly* by the brachial plexus of nerves.

The *external* or *acromial portion* of the artery is practically of much importance, and demands the most pointed examination of the student. It rests upon the scalenus medius muscle and superior surface of the first rib with the brachial plexus to its superior and acromial surface; and the subclavian vein placed anteriorly and inferiorly. It lies in a triangular space immediately above the clavicle, between the sterno-cleido mastoid, and trapezoid muscles, and covered only by the skin, platysma, and fascia of the neck, and some lymphatic ganglia.

Branches. 1st, arteria vertebralis—2d, mammaria interna—3d, axis thyroidea, which divides into the thyroidea inferior, transversalis colli, transversalis humeri—4th, inter-costalis superior—5th, cervicalis profunda: or these branches may be arranged into *ascending*, *descending*, and *transverse*—the *ascending*, including the vertebral and inferior thyroid—the *descending*, the internal mammary and superior intercostal—and the *transverse*, the transversalis colli, the transversalis humeri, and the cervicalis profunda.

1. *Ar. Vertebralis.*—Superior aspect of the subclavian at the outer margin of the longus colli muscle. *Course.* Rises vertically between the longus colli and scalenus anticus muscles, to the sixth cervical vertebra. In ascending the neck, it enters the canal formed by the foramina of the transverse process of the cervical vertebræ. Thus protected, it reaches the head, enters the cranium, between the posterior arch of the atlas and margin of the foramen magnum of the occipital bone. The two vertebrals unite at an acute angle and form the *basilary artery*, which, continued forward to the anterior margin of the *nodus cerebri*, divides into two branches that are lost in the posterior part of the cerebrum, the *proper vertebral* supplying muscles in the neck, the dura mater, and the spinal cord, and the *basilary* the cerebellum and posterior parts of the cerebrum.

2. *Ar. Thyroidea Inferior.*—*Origin.* From the thyroid axis which juts forward from the subclavian arteries at the tracheal margin of the scalenus anticus muscle *Course.* Upwards and inwards, running tortuously behind the carotid artery to the thyroid body or gland, supplying in its course the deep-seated muscles of the neck, the œsophagus and trachea, and thyroid body, in which it terminates.

3. *Ar. Mammaria Interna.*—*Origin.* Inferior aspect of the subclavian opposite the thyroid axis. *Course.* It proceeds forwards, then downwards, into the thorax, crossing, as it descends, the costal cartilages near the sternum, and terminates in the abdominal muscles about the umbilicus, there anastomosing freely with the terminal branches of the epigastric artery. In its

course it supplies intercostal spaces—the thymus body or gland, mediastinum, diaphragm, and abdominal walls.

4. *Ar. Intercostalis Superior.*—*Origin.* Posterior aspect of the subclavian behind the scalenus anticus muscle. *Course.* Backwards, and descends anterior to the neck of the first and second ribs, supplying usually the first and second intercostal spaces.

5. *Ar. Transversalis Humeri, or Supra Scapularis.*—*Origin.* Thyroid axis. *Course.* It descends and runs outwards across the lower part of the neck, protected by the clavicle, and bound down to the subclavius muscle, It clears the superior margin of the scapula at the supra scapulary notch, and reaches the dorsal aspect of the bone to supply parts about the acromion—the supra spinatus and infra spinatus muscles.

6. *Ar. Transversalis Colli.*—*Origin.* Thyroid axis. *Course.* Outward and backwards, crossing the scalenus anticus and brachial plexus of nerves, about two or three inches above the clavicle, and supplying the superficial parts of the neck between the sterno-cleido mastoideus, and trapezius muscles, and more deep-seated parts about the basis of the scapula.

7. *Ar. Cervicalis Profunda.*—*Origin.* Subclavian artery, frequently behind the scalenus anticus. *Course.* It turns immediately backwards to the posterior aspect of the spine, and deep-seatedly ascends to near the occiput, supplying the deep-seated muscles chiefly upon the posterior part of the neck.

Arteria Axillaris.

Origin. Continued from the subclavian. *Course.* Commences at the inferior margin of the first rib, crosses obliquely the axilla, and terminates opposite the inferior margin of the tendon of the teres major muscle.

Relative Situation. In exposing this artery, the student, in the first place, should direct his attention to the form and boundaries of the *axilla* itself. The following points should be noted—its triangular pyramidal form—its *three walls*, the *anterior*, *posterior*, and *internal*—its *three angular margins*, the *anterior*, the *posterior*, and the *external* or *humeral*—its *base*, closed by a dense fascia, and its *apex*, at which the axillary artery enters.

The axillary artery, like the subclavian, is susceptible of a threefold division—an *upper*, a *middle*, and a *lower*—the *first* corresponding with the space between the lower margin of the first rib and superior margin of the pectoralis minor muscle—the *second* with the breadth of the pectoralis minor as it crosses the artery—and the *third* with the space between the lower margin of the pectoralis minor and the base of the axilla. Throughout the axilla, the artery is accompanied by the axillary plexus of nerves and axillary veins; but a different relationship exists between them in each of the three divisions.

Superiorly. The plexus is above and to the acromion side of the artery—in the *middle* the artery transfixes the plexus, and is consequently surrounded by it; and in the *lower third* the nerves from the plexus run collaterally with the vessel;—the median nerve in front, the musculo-spiral and circumflex nerves behind—the external cutaneous nerve to its outer, and the internal cutaneous and ulnar nerves to its inner side. The axillary *vein* along the three divisions lying anteriorly and sternally to both artery and nerves.

Branches. 1st, thoracica humeraria vel acromialis—2d, arteria thoracica superior—3d, thoracica longior—4th, thoracicæ alares — 5th, subscapularis—6th, circumflexa anterior—7th, circumflexa posterior.

1. *Ar. Thoracica Acromialis.—Origin.* Axillary artery immediately above the superior margin of the pectoralis minor muscle. *Course.* It juts forward like an axis, and divides into branches which supply the walls of the chest, the pectoral muscles, the parts about the acromion and deltoid muscle.

2. *Ar. Thoracica Superior.—Origin.* Varies much in different subjects—usually immediately below the origin of the former. *Course.* A small branch that inclines forwards and inwards to the pectoral muscles, and upper part of the thoracic walls.

3. *Ar. Thoracica Longior.—Origin.* Opposite the lower margin of the pectoralis minor muscle. *Course.* Descends upon the walls of the thorax, between the pectoralis major and serratus anticus muscles, nearly to the base of the thorax, supplying the lateral parts of the thorax superficially and deep-seatedly.

4. *Ar. Thoracica Alaris.—Origin.* The most irregular and uncertain of all the branches of the axillary. When it arises as a distinct branch, it proceeds from about the middle part of the axillary artery across the axilla, dividing into branches that form a network, from which branches proceed to the axillary glands and part of the walls of the axilla.

5. *Ar. Subscapularis.—Origin.* Opposite the neck of the scapula. *Course.* Extends along the inferior margin of the subscapularis muscle, and supplies parts upon the dorsal aspect of the scapula, upon the anterior aspect of that bone, and at the inferior angle of the scapula—the latissimus dorsi and serratus major anticus muscle.

6. *Ar. Circumflexa Posterior.—Origin.* Posterior part of the axillary, generally immediately below the arteria subscapularis. *Course.* Outwards and backwards, it immediately leaves the axilla; and encircling the neck of the humerus, is lost upon the inner surface of the deltoid muscle.

7. *Ar. Circumflexa Anterior.—Origin.* Front of the axillary artery, a little below the origin of the former vessel. *Course.* Outwards and forwards close to the humerus, round which it

bends to the inner surface of the deltoid muscle, which it supplies; as also the muscles and nerves under which it passes, and the internal parts of the shoulder joint.

Arteria Humeralis.

Origin.—Continued from the lower extremity of the axillary artery. *Course.* Obliquely downwards and forwards along the inner side of the upper arm, as far as the bend of the elbow, where it terminates, by dividing into the radial and ulnar arteries. *Anteriorly* covered by the skin, fascia, coraco-brachialis muscle, the inner margin of the biceps, and at the bend of the elbow, by the aponeurosis of the biceps, and superficial veins, and by the pronator teres muscles. *Posteriorly.* Resting upon the triceps, tendinous insertion of the coraco-brachialis, and the brachialis internus muscle. The artery is still farther accompanied by its two venæ comites, and by the median and internal cutaneous nerves, and sometimes also, and more superficially, by the basilic vein. At the superior part of the artery, the external cutaneous nerve also lies to its outer side, the ulnar nerve to its inner side, and the musculo-spiral nerve to its posterior aspect.

1. *Ar. Profunda Superior.*—*Origin.* Posterior aspect of the humeral aspect, below the insertion of the teres major muscle. *Course.* downwards and backwards, for someway betwixt the long head of the triceps and the humerus; it then takes a spiral course outwards behind the bone, and reaches the radial side of the elbow-joint. It supplies the triceps coraco-brachialis, elbow-joint, and anastomosis, with the recurrent branch of the radial artery.

2. *Ar. Profunda Inferior.* *Origin* Humeral artery opposite the insertion of the coraco-brachialis, muscle. It extends along the inner side of the humeral artery to the depression between the internal condyle of the humerus and olecranon, where it inosculates with the posterior ulnar recurrent artery, and supplies in its course the third head of the triceps—the brachialis anterior, and the integuments.

3. *Ar. Anastomotica Magna.*—*Origin.* From the humeral artery about two or three fingers' breadth above the elbow. *Course.* Crosses the brachialis anterior muscle, in the direction of the condyle of the humerus, pierces the inter-muscular septum, and at the posterior part of the internal condyle anastomosis, with the profunda inferior and ulnar recurrent.

Arteria Radialis.

Origin. From the lower extremity of the humeral artery. *Course.* Along the anterior and radial part of the fore-arm, from the bend of the elbow to the carpus. It passes them by the radial side of the wrist-joint, to the dorsal aspect of the hand, and reaches the cleft between the metacarpal bone of the thumb and fore finger, where it sinks into the palm, to form the deep-seated palmar arch.

Relative situation. 1st, *in the fore arm.* It descends at first deep-seatedly, between the pronator teres and supinator longus, and in the middle and lower part of its course, it lies more superficially between the supinator longus and flexor carpi radialis, accompanied by its venæ comites and the radial nerve, and at the wrist is covered only by the skin and fascia of the fore arm. *Posteriorly*, the artery, as it descends, is in succession in contact with the following parts:—the tendon of the biceps, branches of the musculo-spiral nerve, the supinator brevis muscle, tendon of the pronator teres, radial origin of the flexor sublimis, flexor pollicis, pronator quadratus, and inferior extremity of the radius—2d, *on the carpus.* As the artery turns round the carpus, it lies on the external lateral ligament of the wrist-joint, and head of the first metacarpal bone, and is covered by the skin, fascia, and the extensor muscles of the thumb—3d, *In the palm.* It takes the name of palmaris profunda, and lies behind the tendons of the long flexors and lumbricales, crossing the upper extremity of the metacarpal bones, and at the ulnar edge of the hand anastomosing with a branch of the ulnar artery. *Branches:* 1st, recurrens radialis—2d, superficialis volæ—3d, dorsalis radialis—4th, dorsalis carpi—5th, dorsalis metacarpi—6th, dorsalis pollicis—7th, palmaris profunda.

1. *Recurrens Radialis. Origin.* At the upper part of the radial artery. *Course.* The vessel runs first outwards, then turns upwards upon the supinator brevis muscle, and ascends anterior to the external condyle of the humerus, between the supinator longus and brachialis anterior muscles, supplying the parts about the radial side of the elbow-joint.

2. *Ar. Superficialis Volæ.—Origin.* A small branch that stretches from the radial artery near the wrist, over the annular ligament of the carpus, and origin of the small muscles of the thumb to the palm, where it usually joins the superficial palmar arch.

3. *Ar. Anterior Carpi Radialis.* A very small branch that stretches across the lower extremity of the radius, under the flexor muscles, and supplies the anterior part of the carpus and palmar interosseous muscles.

4. *Ar. Dorsalis Carpi Radialis.* A pretty regular branch that crosses the dorsal aspect of the carpus under the exterior tendons, and supplies the carpal bones and articulations.

5. *Ar. Dorsalis Pollicis.* Usually two small branches that

run along the dorsal aspect of the thumb, the one along its radial, and the other along its ulnar edge.

6. *Ar. Magna Pollicis.* A large vessel that descends by the ulnar side of the metacarpal bone of the thumb, and then divides into two branches, that coast the radial and ulnar margins of the first and second bone of the thumb, and anastomose at the inferior extremity of the last or distal bone.

7. *Ar. Radialis Indicis.* A branch that corresponds with the radial edge of the index finger.

Arteria Ulnaris.

Origin. Lower extremity of the humeral artery. *Course.* Along the anterior and ulnar part of the fore-arm from the bend of the elbow to the palm of the hand and fingers. *Relative Situation.* In the *superior third* of the fore-arm, it is covered by the skin, fascia, pronator teres, flexor carpi radialis, palmaris longus and flexor sublimis muscles and median nerve. In the *two inferior thirds* of the fore-arm it lies more superficially, but under the protection of the flexor carpi ulnaris muscle which overlaps it, and in company with its venæ comites and ulnar nerve. It passes into the hand by the side of the os pisiforme, and descends behind the palmaris brevis muscle, and palmar aponeurosis, forming the superficial palmar arch, from which the fingers are supplied by branches, which descend on their radial and ulnar edges. *Branches.* 1st, recurrens ulnaris anterior—2d, recurrens ulnaris posterior—3d, interossea—4th, anterior carpi—5th, posterior carpi—6th, communicans—7th, palmaris superficialis.

1. *Ar. Recurrens Anterior.—Origin.* About an inch below the origin of the ulnar artery, sometimes in common with the next branch. *Course.* It passes upwards behind the pronator teres muscle to the anterior surface of the elbow joint, and to the brachialis anterior muscle, on all of which it ramifies.

2. *Ar. Recurrens Posterior.* A larger and more important artery than the anterior, and which turns upwards behind the flexor carpi ulnaris in contact with the ulnar nerve—passes betwixt the origins of the flexor carpi ulnaris, reaches the lower part of the triceps muscle, and supplies in its course the parts about the inner side of the elbow joint both superficially and in the inferior of the joint

3. *Ar. Interossea.—Origin.* Nearly opposite the superior margin of the interosseous ligament. *Course.* The largest branch of the ulnar proceeds backward till it reaches the interosseous ligament, and descends upon its anterior surface as far as the pronator quadratus muscle. Passing behind that muscle, it pierces the interosseous ligament, and terminates on the dorsal

aspect of the hand, transmitting branches in its course to the anterior part of the elbow joint, to the posterior part of that joint, to the posterior muscles generally of the fore-arm, and to the anterior as well as posterior parts of the hand.

4. *Ar. Carpi Ulnaris Anterior.* } Branches similar to these
5. *Ar. Carpi Ulnaris Posterior.* } that arise from the radial, and with which they anastomose.

6. *Ar. Communicans.* Passes backwards from the ulnar below the os pisiforme and between the flexor brevis and abductor minimi digiti muscles, and anastomoses with the radial, and assists in forming the deep palmar arch.

7. *Ar. Palmaris Superficialis.* When the ulnar artery reaches the palm, it forms an arch, the convexity of which is turned forwards, and from which small branches proceed to superficial and deep-seated parts in the palm of the hand; and larger branches to the fingers, each finger being supplied by two branches, one extending along its radial and another along its ulnar side, and anastomosing freely at the point of the fingers.

II.—DESCENDING THORACIC AORTA AND ITS BRANCHES.

The descending thoracic aorta extends from the fourth dorsal vertebra to the diaphragm, and its relationship to the bodies of the vertebræ along which it passes, and the organs in the posterior mediastinal space in which it lies, should be particularly observed by the student. The following particulars should be noted—1st, its great size—2d, its obliquity from above downwards, and from left to right—3d, its contiguity to the vertebral column, to the vena azygos and thoracic duct, and to the œsophagus and pneumogastric nerves—4th, its exit from the thorax between the crura of the diaphragm.

The branches that arise from this division of the aorta are small—some of them arising from the *anterior* and others from the *posterior*, as part of the great trunk: the *anterior* branches supplying the lungs and œsophagus chiefly, and the *posterior* branches the spine, the intercostal spaces and thoracic walls generally. The relationship which the intercostal arteries bear to the inferior margin of the ribs is a point of practical import.

The branches of the ascending aorta are usually found arising in the following manner:—

1. *Arteria Bronchialis Superior.—Origin.* Anterior aspect of the aorta, usually opposite the fourth or fifth dorsal vertebra. *Course.* Stretches forward in the posterior mediastinal space to the root of the lungs, to ramify upon these organs.

2. *Arteria Bronchialis Inferior.—Origin.* Anterior aspect of the aorta below the origin of the former artery. *Course.* Similar to the former.

3. *Arteriæ Œsophageæ.—Number.* From two to six. *Origin.*

Anterior aspect of the aorta. *Course.* They run for a little way, and ramify on the œsophagus.

4. *Arteriæ Posteriores Mediastini.—Number.* Various. *Origin.* Anterior part of the aorta. These vessels are small and chiefly supply the vessels and cellular membrane of the posterior mediastinum.

5. *Arteriæ Intercostales Inferiores.—Number.* From eight to ten on each side. *Origin.* Posterior part of the aorta. *Course.* Transversely to the lateral part of the vertebral column and to the eight or ten inferior intercostal spaces which they supply.

III.—ABDOMINAL AORTA AND ITS BRANCHES.

This division of the aorta stretches from the junction of the *crura diaphragmatis*, opposite the superior margin of the first lumbar vertebra, to the junction of the fourth and fifth lumbar vertebræ, where it usually bifurcates into the two *common iliac* arteries: the arteries of the *inferior* extremities. After the intestines have been removed, the size and curvilinear direction of this portion of the aorta should be observed, and its relationship to the stomach, solar plexus of nerves, pancreas, duodenum, vena portæ, and transverse position of the colon, all of which cross the vessel, and should be particularly noted; and also to the vena cava inferior and sympathetic nerves which run parallel with it.

The branches of the abdominal aorta may be variously arranged, 1st, into those branches that supply the abdominal viscera and those that supply the abdominal walls; or, 2d, into those that are found to arise from the *anterior* aspect of the aorta, those from the *lateral* aspect, and those from the *posterior;* or, 3d, the order in which they arise in immediate succession from above downwards, as in the following notification:—

1st, Arteria phrenica—2d, axis cœliaca—3d, arteria mesenterica superior—4th, arteriæ capsulares—5th, arteriæ renales—6th, arteriæ spermaticæ—7th, arteria mesenterica inferior—8th. arteriæ lumbales—9th, arteria sacri media.

1. *Arteria Phrenica (Dextra and Sinistra).—Origin.* Anterior part of the aorta immediately above the cœliac axis. *Course.* The phrenica dextra crosses the right crus of the diaphragm, and ramifies on the corresponding half of that muscle—the phrenica sinistra crosses the left crus, and is confined to the left side of the same muscle.

2. *Axis Cœliaca.—Origin.* Anterior aspect of the abdominal aorta, opposite the lower margin of the last dorsal vertebra. *Course.* It juts forwards about half an inch, when it divides into three branches—1st, arteria gastrica—2d, arteria hepatica—3d,

arteria splenica, or branches that supply respectively the stomach, liver, and spleen.

1. *Arteria Gastrica.*

Origin. From the cœliac axis. *Course.* Along the small curvature of the stomach, from the œsophageal orifice to the pylorus.

2. *Arteria Hepatica.*

Origin. From the cœliac axis. *Course.* Transversely to the right side, as far as the transverse fissure of the liver, into which it enters, and in its course transmits branches that supply the pyloric extremity of the stomach, the duodenum, pancreas, the right half of the great curvature of the stomach, and corresponding part of the great omentum, and gall-bladder as well as the liver.

3. *Arteria Splenica.*

Origin. Cœliac axis. *Course.* Transversely to the left side along the superior margin of the pancreas, as far as the spleen which it enters, and supplies in succession the pancreas, the splenic extremity of the stomach, the spleen, the left half of the great curvature of the stomach, and corresponding part of the omentum.

3. *Arteria Mesenterica Superior.—Origin.* Anterior aspect of the aorta, a little below the cœliac artery. *Course.* It descends between the laminæ of the mesentery as far as the right iliac region, in its course transmitting branches to the *left side*, that supply the jejunum and ilion; and to the *right side*, that supply the tube at the junction of the ilion and colon—the *right side* of the colon, and the *transverse portion* of the colon.

4. *Arteriæ Capsulares.—Number.* One or more on each side. *Origin.* Lateral parts of the aorta opposite the superior mesenteric artery. *Course.* Obliquely upwards and outwards to the renal capsules, and surrounding cellular membrane.

5. *Arteriæ Renales.—Number.* Usually two, one on each side. *Origin.* Lateral and anterior part of the aorta, a little below the origin of the superior mesenteric. *Course.* Each artery runs obliquely downwards, and transversely to the kidney in which it ramifies.

6. *Arteriæ Spermaticæ.—Number.* Two, one for each side. *Origin.* Anterior part of the aorta below the emulgent. *Course.* In the male, each artery runs obliquely downwards and outwards, to the inguinal canal, through which it passes, and descends along the spermatic cord to the *testicle.* In the female the arteries descend to the *ovaries.*

7. *Arteria Mesenterica Inferior.—Origin.* Anterior part of

the aorta, about an inch above its bifurcation. *Course.* Obliquely downwards and outwards, to the left iliac region, when it supplies the left side of the colon, the sigmoid flexure of the colon, and the greatest part of the rectum.

8. *Arteriæ Lumbales.—Number.* Five on each side. *Origin.* Posterior aspect of the aorta, opposite the lumbar intervertebral ligaments *Course.* Across to the lateral part of the spine, which they supply, and to the abdominal muscles upon which their principal branches terminate.

9. *Arteria Sacri Media.—Origin.* Posterior aspect of the aorta, a little above its bifurcation. *Course.* Mesial line of the sacrum, as far as the coccyx.

ARTERIES OF THE INFERIOR EXTREMITIES.]

The arteries of the inferior extremity are branches of a great arterial tube that extends from the lower end of the aorta to the foot. The student should first attend to the course and subdivisions of this central arterial pipe, and then to the branches sent off in succession from its upper to its lower part, where it ultimately terminates upon the extremities of the toes.

Arteria Iliaca Communis (Dextra and Sinistra).

Origin. The common iliac arteries result from the bifurcation of the aorta. *Course.* From about the junction of the fourth and fifth lumbar vertebræ, obliquely downwards and outwards to the sacro-iliac symphysis, where they divide into the internal and external iliac arteries. *Relative Situation.* The two iliac arteries differ a little in size and relative situation. The *right iliac* is larger than the left, and crosses anteriorly the left common iliac vein, and the commencement of the inferior vena cava. It is bounded on the right side by the cœcum, and is crossed anteriorly by the ureter, and frequently by the vermiform process of the cœcum. The *left iliac* descends with less obliquity than the right, bounded behind and internally by the left common iliac vein—on the left side by the sigmoid flexure of the colon, and crossed anteriorly by the ureter and rectum.

Arteria Iliaca Interna.

Origin. Continued from the common iliac artery. *Course.* Vertically into the pelvis anterior to the sacro-iliac junction, as far as the sacro-sciatic notch. *Relative Situation.* Bounded behind by the internal iliac vein and lumbo-sacral nerve, and anteriorly crossed by the ureter, and vas deferens. *Branches.* 1st, ilio-lumbalis—2d, sacri lateralis—3d, umbilicalis—4th, vesicalis—5th, hæmorrhoidalis media—6th, obturatoria—7th, glutea—8th, ischiadica—9th, pudica interna; and in the female the two following—10th, uterina—11th, vaginalis. Such is the manner in which these vessels usually arise; but this may be still farther grouped into two sets—1st, internal—and 2d, external branches. The *first* supplying the pelvic viscera and the inner parts chiefly of the pelvic walls; and the *second* leaving the pelvic cavity to ramify upon more superficial or external parts. The first five of the arteries above enumerated fall under the first class, the next four under the last, whilst the remaining two, existing only in the female, must be ranked of course among the internal branches.

The internal iliac arteries differ most remarkably in the fœtus and adult. In the fœtus they are the vessels that, besides ramifying as in the adult, convey the blood from the child into the placenta of the mother, and are found to turn up from the pelvis along the side of the bladder till they reach the urachus, along which they run to the umbilicus, and there forming a part of the umbilical cord, they are continued to the placenta.

Arteria Iliaca Externa.

Origin. Continued from the lower extremity of the common iliac. *Course.* Outwards and downwards, to the middle of Poupart's ligament, when it becomes the common femoral artery. *Relative Situation.* When the abdominal walls and viscera are removed, the artery is seen to descend by the inner side of the psoas magnus muscle, covered by the peritoneum and a thin process of the fascia iliaca, and bounded on the pubic side by the external iliac vein. Near Poupart's ligament the artery is bounded posteriorly by the psoas magnus muscle and fascia iliaca. *Branches.* 1st, epigastrica—2d, circumflexa ilii.

1. *Ar. Epigastrica.—Origin.* Inner side of the external iliac, usually a little way above Poupart's ligament. *Course.* Turns up behind Poupart's ligament, and ascends upon the abdominal walls—runs upwards and inwards by the pubic side of the internal inguinal opening to the posterior surface of the rectus muscle, on which it ascends as far as the umbilicus, supplying in its course the spermatic cord, the abdominal walls and anastomosis with the internal mammary artery.

2. *Ar. Circumflexa Ilii.—Origin.* Anterior and external part of the external iliac artery behind Poupart's ligament. *Course.* Upwards and outwards to the anterior superior spine of the ilium, and curves along the inner side of the crest of the ilium, and anastomoses with branches of the ilio-lumbalis.

Arteria Femoralis Communis.

Origin. Continued from last mentioned artery. *Course.* Descends upon the groin for about an inch and a half, when it divides into the internal or deep, and external or superficial femoral. *Relative Situation.* This vessel lies in a triangular space formed by the divarication superiorly of the pectineus and iliacus internus muscles, bounded posteriorly by the psoas magnus muscle, accompanied by the femoral vein, which lies upon its inner or pubic side, and by the anterior crural nerve upon its iliac side, the nerve usually somewhat sunk between the psoas magnus and iliacus muscles, and the vessel covered by the skin, fascia superficialis, fascia cribriformis, glands, and part of the fascia lata and sheath of the femoral vessels. *Branches.* 1st, epigastrica superficialis—2d, pudicæ externæ—3d, circumflexa illi superficialis.

1. *Ar. Tegumentosa Abdominis*, or *Epigastrica Superficialis.—Origin.* About an inch below Poupart's ligament. *Course.* Pierces the fascia lata, and ascends upon the abdominal walls embedded in the superficial fascia, and parallel with the internal epigastric, and supplying chiefly the integuments.

2. *Ar. Pudicæ.* Usually two small branches that arise below, and near the origin of the former vessel that stretch across to the pubes and external organs of generation.

3. *Ar. Circumflexa Ilii Superficialis.—Origin.* Immediately below the former, and frequently very small. *Course.* Nearly parallel to Poupart's ligament, in the direction of the spine of the ilium, near which it terminates upon the integuments.

Arteria Femoralis Interna vel Profunda.

Origin. Lower extremity of the *common* femoral artery. *Course.* From its origin it runs obliquely downwards and backwards between the adductor muscles of the thigh and the vastus internus as far as the middle of the femur. *Relative Situation.* From its origin it turns rather to the external or iliac side of the common femoral, then inwards towards the femur, and descends behind and parallel with the superficial femoral, but at a distance from it. *Branches.* 1st, circumflexa externa—2d, circumflexa interna—3d, perforans prima—4th, perforans secunda—5th, perforans tertia.

1. *Ar. Circumflexa Externa.—Origin.* External aspect of the profunda, near the origin of that vessel. *Course.* The trunk of the vessel, which is short, runs outwards, and soon divides into branches that take three different directions, some ascending to the gluteal region, others bend round the upper part of the shaft of the thigh, among the deep-seated muscles, and some of the larger branches descend to the outer part of the knee, and inosculate with branches of the popliteal artery.

2. *Ar. Circumflexa Interna.—Origin.* Posterior aspect of the profunda, generally opposite or near the origin of the external

circumflex. *Course.* Backwards and inwards above the trochanter minor to supply the hip joint and muscles of the upper, internal, and posterior part of the thigh.

3. *Ar. Perforans Prima.—Origin.* Nearly opposite the trochanter minor. *Course.* Backwards between the tendons of the pectineus and abductor brevis, then perforates the abductor magnus muscle, and supplies the gluteus maximus and upper part of the hamstring muscles.

4. *Ar. Perforans Secunda.* The principal perforating artery—passes deep among the muscles of the thigh, and piercing in succession the abductor brevis and magnus muscles, ramifies chiefly upon the hamstrings.

5. *Ar. Perforans Tertia.—Origin.* About the middle third of the thigh. *Course.* Passes backward, perforates the abductor magnus muscle, and assists the other perforating branches in supplying the muscles on the posterior part of the thigh.

Arteria Femoralis Externa vel Superficialis.

Origin. Continued from the *common* femoral artery. *Course.* Along the anterior and internal part of the thigh, from the point where the profunda is given off, to the canal in the adductor muscles through which it passes, when it takes the name of popliteal. *Relative Situation.* This is the most important vessel of the limb, and its course and relations demand the most careful examination of the student. In the dissection of this vessel, the skin, superficial fascia and fascia lata, and inguinal glands, should be removed from the two superior thirds of the anterior and inner parts of the thigh, and the superficial muscles cleaned but not raised. The following points will then require to be studied:—1st, The triangular space corresponding with the upper third of the thigh, *bounded* on the *outer side* by the sartorius; on the *inner* by the adductor longus—the *base* of the triangle formed by Poupart's ligament, and the *apex* by the crossing of the sartorius and adductor longus. 2d, The exposed condition of the artery in this space, and its relationship to the *common femoral* artery, which is continuous with it superiorly, as well as with the *profunda* which lies behind it, but deep-seatedly. 3d, Its relationship to the superficial femoral *vein* which lies immediately behind and in contact with the artery—to the branches of the anterior crural nerve that descends externally to its sheath—and to the nervus saphenus that penetrates the sheath near the apex of this space, and descends in contact with the artery. 4th, The relations of the artery in the *middle third* of the thigh, where it is covered by the skin, superficial fascia, fascia lata, sartorius muscle, deep-seated fascia, and sheath—lodged in a deep groove, and accompanied by the femoral vein and nervus saphenus. 5th, The transit of the artery at the junction of the middle with the inferior third of the thigh through a canal—the structure of which should be examined—into the popliteal space. *Branches.* 1st, musculares—2d, anastomotica magna.

1. *Ar. Musculares.* Numerous but generally small and irregular branches that supply the sartorius and other muscles on the anterior part of the thigh.

2. *Ar. Anastomotica Magna.* When the femoral is about to enter the canal in the triceps muscle, this branch is sent off, and descends to the inner side of the knee, and inosculates freely with the internal articular arteries.

Arteria Poplitea.

Origin. Continued from the superficial femoral artery. *Course.* Along the lower third of the posterior surface of the femur, and upper fourth of the posterior surface of the tibia. It divides into the anterior and posterior tibial arteries. *Relative Situation.* The popliteal space or ham through which this artery passes, is situated behind the knee joint, extending upwards upon the femur, between the hamstring muscles and a little downwards upon the tibia, between the two heads of the gastrocnemius muscle. Its walls and boundaries require the particular examination of the student. In descending through this space, the artery is bounded *before* by the lower part of femur—by posterior surface of the knee-joint and popliteus muscle—*behind* by the skin, superficial fascia, fascia lata, semimembranosus muscle superiorly, and gastrocnemius externus inferiorly;—*on the tibial side* by the semitendinosus, semimembranosus, and inner head of gastrocnemius;—*on the fibular side* by the triceps, outer head of gastrocnemius and plantaris. The separation of the outer and inner hamstrings at the knee, and of the origins of the gastrocnemius muscle, forms a deep space behind the knee joint, in which the artery is found, accompanied by the popliteal vein and branches of the great sacro-sciatic nerve. These nerves called the external and internal popliteal, lie immediately under the fascia, the vein next and most deep-seatedly the artery. *Branches.* 1st, articularis superior externa—2d, articularis superior interna—3d, articularis media—4th, articularis inferior externa—5th, articularis inferior interna—6th, surales.

1. *Ar. Articularis Superior Externa.—Origin.* External or fibular side of the popliteal. *Course.* Upwards and outwards above the external condyle of the femur, turns round the bone, and descends to the patella, supplying in its course superficial and deep-seated parts of the knee joint.

2. *Ar. Articularis Superior Interna.—Origin.* Internal aspect of the popliteal. *Course.* Inwards close to the bone, turns

round above the internal condyle, and after supplying superficial and deep-seated parts of the joint, stretches to the patella.

3. *Ar. Articularis Media* or *Azyga.—Origin.* Anterior aspect of the popliteal artery, generally opposite the bend of the knee. *Course.* Pierces the posterior ligament, and ramifies upon the internal parts of the joint.

4. *Ar. Articularis Inferior Externa.—Origin.* From the outer side of the popliteal. *Course.* Passes directly outwards behind the external lateral ligament, immediately above the head of the fibula, and extends to the patella, and in its course supplies the joint.

5. *Ar. Articularis Inferior Interna.—Origin.* External aspect of the popliteal below the origin of the former. *Course.* Downwards and inwards, turns round the inner margin of the tibia, protected by the internal lateral ligament of the knee-joint, then ascends to the patella and supplies muscles, the head of the tibia, the ligament of the patella, and front part of the joint.

Arteria Tibialis Antica.

Origin. From the bifurcation of the popliteal artery. *Course.* Passes forward between the fibres of the tibialis anticus muscle and above the interosseous ligament, and descends along the anterior part of the interosseous ligament and tibia, to the ankle: it is then continued along the back of the foot, to the space between the first and second metatarsal bones, when it passes to the sole of the foot, and anastomoses with the external plantar artery. *Relative Situation.* In the superior third of the leg, the artery lies between the tibialis anticus and extensor longus pollicis, and at the ankle is crossed obliquely by the last mentioned muscle. Corresponding with the *two superior thirds of the leg*, the artery lies deep, in contact with the interosseous ligament, but becomes much more superficial upon the inferior third of the tibia and at the ankle. The artery throughout this course is accompanied by two venæ comites and the anterior tibial nerve. The artery crosses the ankle-joint between the annular ligament and synovial membrane, and stretches to the first interosseous space over the astragalus, os naviculare, and internal cuneiforme bone, covered by the skin, common integuments, and crossed by the internal tendon of the extensor brevis digitorum pedis muscle. *Branches.* 1st, recurrens—2d, malleolaris interna—3d, malleolaris externa—4th, arteria tarsi—5th, arteria metatarsi—6th, communicans—7th, dorsalis pollicis pedis.

1. *Ar. Recurrens Tibialis.—Origin.* At the upper margin of the interosseous ligament. *Course.* It turns upwards, passing

through the tibialis anticus muscle to the knee and anastomoses with articular branches.

2. *Ri. Musculares.*—Numerous but small branches, that supply the muscles among which the anterior tibial artery descends.

3. *Ar. Malleolaris Interna.*—*Origin.* About an inch above the internal malleolar process. *Course.* Downwards and inwards to the internal malleolar process and inner side of ankle.

4. *Ar. Malleolaris Externa.*—*Origin.* Nearly opposite the former. *Course.* Extends to the external malleolar process, close to the bone, supplying the lower extremity of tibia and fibula, and external part of the ankle-joint.

5. *Ar. Tarsi.*—*Origin.* From the anterior tibial artery at the os naviculare. *Course.* Obliquely across the tarsus to the fibular edge of the foot, supplying the extensor brevis digitorum—the bones and joints of the tarsus.

6. *Ar. Metatarsi.*—*Origin.* Anterior tibial artery, near the first metatarsal bone. *Course.* Obliquely across the posterior extremities of the metatarsal bones to the fibular edge of the foot, supplying the muscles of the 2d, 3d, and 4th interosseous spaces.

7. *Ar. Pollicis.*—*Origin.* From anterior tibial, when about to pass into the sole of the foot. *Course.* Along the first interosseous space to the great toe, and part of the second toe.

Arteria Tibialis Postica.

Origin. Continued from the popliteal artery. *Course.* It descends from opposite the inferior margin of the popliteus muscle between the superficial and deep-seated posterior muscles of the leg to the sinuosity of the os calcis. In the sole of the foot it terminates in the plantar arteries, from which the toes are supplied. *Relative Situation.* In its upper and middle thirds, the artery is covered by the gastrocnemius and soleus muscles, and in the inferior third by the integuments and superficial and deep-seated fasciæ of the leg. As it descends, the artery is bound down by the deep-seated fascia to the following parts:—*superiorly*, to the tibialis posticus muscle—in the *middle* of the leg, to the flexor digitorum communis, and near the ankle to the tibia, where it lies nearly midway between the most prominent part of the internal malleolar process of the tibia and the *tendo Achillis*. *Branches.* 1st, peronea—2d, nutritia tibiæ—3d, plantaris interna—4th, plantaris externa.

1. *Ar. Peronea.*—*Origin.* From the posterior tibial, about an inch below the popliteus muscle. *Course.* This, the principal branch of the posterior tibial artery, runs first obliquely downwards and outwards, and then descends very deep-seatedly by the inner side of the fibula to the ankle to supply the anterior

part of the ankle and dorsum of the foot, to the back part also of the ankle and side of the os calcis.

2. *Ar. Nutritia Tibiæ.—Origin.* Variable, usually below the origin of the former. *Course.* Descends upon the posterior surface of the bone—lies in a groove that conducts the artery into the interior of the bone, and supplies the medullary membrane.

3. *Ar. Plantaris Interna.* The smaller plantar branch, that extends along the tibial side of the sole of the foot to the integuments of the great toe.

4. *Ar. Plantaris Externa.—Origin.* The continuation of the posterior tibial in the sole of the foot. *Course.* Downwards, outwards, and forwards, as far as the metatarsal bone of the little toe, when it turns inwards and upwards to the first interosseous space, and inosculates with the anterior tibial. In this course it supplies muscles and integuments of the foot and the toes, each toe being supplied with two branches—one which takes the tibial, and the other the fibular edge, and anastomose freely at the extremity of the toe.

TABLE OF THE ARTERIES.

I.—PULMONARY ARTERY

II.—AORTA.

AORTA DIVIDED INTO THREE PORTIONS:

1st, The Arch—2d, Descending Thoracic Portion—3d, Abdominal Portion.

I.—ARCH OF THE AORTA:

From which arise,

1st, Coronaria Anterior Cordis—2d, Coronaria Posterior Cordis—3d, Arteria Innominata, which divides into Carotica Dextra, and Subclavia Dextra—4th, Carotica Sinistra—5th, Subclavia Sinistra.

CAROTICA DEXTRA ET SINISTRA, OR PRINCIPAL ARTERIES OF THE NECK AND HEAD.

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
Arch of the Aorta. Carotica Communis. CaroticaExterna, Carotica Interna.		
Arteria Carotica Externa.	1st, Ar. Thyroidea Superior.	1. Rs. Hyoideus 2. Rs. Sterno-mastoideus 3. Ri. Laryngei 4. Rs. Thyroideus
	2d, Ar. Lingualis.	1. Rs. Hyoideus 2. Rs. Dorsalis Linguæ 3. Rs. Sublingualis 4. Rs. Raninus
	3d. Ar. Facialis.	1. Rs. Palatinus Inferior 2. Rs. Tonsillaris 3. Ri. Glandulares 4. Rs. Submentalis 5. Ri. Masseterici 6. Rs. Labii Inferioris 7. Rs. Coronarius Inferior 8. Rs. Coronarius Superior 9. Rs. Buccales 10. Ri. Nasi Laterales 11 Rs. Angularis Oculi

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
Arteria Carotica Externa.	4th, Ar. Occipitalis.	1. Ri. Glandulares
		2. Rs. Meningeus Posterior
		3. Ri. Musculares
	5th, Ar. Post. Auris.	1. Ri. Musculares
		2. Ri. Glandulares
		3. Rs. Stylo-mastoideus vel Tympani
		4. Rs. Auricularis
	6th, Ar. Pharyngea Inferior.	1. Ri. Interni
		2. Ri. Externi
		3. Ri. Nasalis Postici
		4. Ri. Meningei
	7th, Ar. Temporalis.	1. Ri. Parotidei
		2. Rs. Transversalis Faciei
		3. Rs. Temporalis Medius
		4. Ri. Capsulares
		5. Ri. Anteriores Auris
		6. Rs. Temporalis Anterior
		7. Rs. Temporalis Posterior
	8th, Ar. Maxillaris Interna.	1. Rs. Meningeus Magnus
		2. Maxillaris Inferior
		3. Ri. Temporalis Profundi
		4. Rs. Massetericus
		5. Ri. Pterygoidei
		6. Ri. Buccales
		7. Rs. Alveolaris Superior
		8. Rs. Infra Orbitalis
		9. Rs. Palatinus Superior
		10. Rs. Nasalis

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
Arteria Carotica Interna.	1st, Ar. Receptaculi.	1. Ri. Anteriores 2. Ri. Posteriores
	2d, Ar. Ophthalmica.	1. Rs. Lachrymalis 2. Rs. Centralis Retinæ 3. Rs. Supra-Orbitalis 4. Ri Ciliares 5. Ri. Musculares 6. Ri. Ethmoidales 7. Ri. Palpebrarum 8. Ri. Nasales 9. Ri. Frontales
	3d, Ar. Communicans Posterior.	
	4th, Ar. Anterior Cerebri.	1. Rs. Communicans Anterior 2. Rs. Corporis Callosi 3. Rs. Prof. Anterior
	5th, Ar. Media Cerebri.	1. Rs. Choroideus 2. Rs. Superficialis 3. Rs. Profundus

SUBCLAVIA (DEXTRA ET SINISTRA),

Commencing Arteries of the Superior Extremity.

Arteria Subclavia.	1st, Ar. Vertebralis, dextra, and sinistra. Ar. Basilaris.	1. Ri. Spinales 2. Ri. Cerebelli Postici 3. Ri. Cerebelli Anteriores 4. Ri. Cerebri
	2d, Ar. Thyroidea Inferior.	1. Rs. Ascendens Colli 2. Rs. Thyroideus Ar. Thyroideæ
	3d, Ar. Mammaria Interna.	1. Ri. Intercostales Anteriores 2. Ri. Mediastini—Thymici 3. Rs. Comes Nervi Diaphragmatici 4. Rs. Musculo-Phrenicus 5. Ri. Abdominales
	4th, Ar. Intercostalis Superior.	1. Rs. Spinalis 2. Rs. Dorsalis 3. Ri. Intercostales

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
Arteria Subclavia	5th, Ar. Transversalis Cervicis.	1. Rs. Cervicalis Superficialis 2. Rs. Scapularis Post.
	6th, Ar. Transversalis Humeri	1. Rs. Acromialis Superior 2. Rs. Supra Spinatus 3. Rs. Infra Spinatus
	7th, Cervicalis Profunda	1. Ri. Ascendentes 2. Ri. Descendentes
Arteria Axillaris	1st, Ar. Thoracica Humeraria vel Acromialis	
	2d, Ar. Thoracica Superior	
	3d, Ar. Thoracica Longior	
	4th, Ar. Thoracica Alaris	
	5th, Ar. Subscapularis	1. Rs. Posterior 2. Rs. Anterior
	6th, Ar. Circumflexa Anterior	
	7th, Ar. Circumflexa Posterior	
Arteria Humeralis	1st, Ar. Profunda Superior	1. Rs. Internus 2. Rs. Externus
	2d, Ar. Profunda Inferior	
	3d, Ar. Anastomotica Magna	
Arteria Radialis	1st, Ar. Recurrens Radialis	
	2d, Ar. Superficialis Volæ	
	3d, Ar. Carpi Radialis Anterior	
	4th, Ar. Dorsalis Carpi Radialis	

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
Arteria Radialis.	5th, Ar. Dorsalis Pollicis	
	6th, Ar. Magna Pollicis	
	7th, Ar. Palmaris Profunda	1. Ri. Superiores 2. Ri. Inferiores 3. Ri. Perforantes
Arteria Ulnaris.	1st, Ar. Recurrens Anterior	
	2d, Ar. Recurrens Posterior	
	3d, Ar. Interossea Communis	1. Ri. Recurrentes Anteriores 2. Rs. Interosseus Anterior 3. Rs. Interosseus Post. *a* Recurrens *b* Descendens
	4th, Ar. Carpi Ulnaris Anterior	
	5th, Ar. Carpi Ulnaris Posterior	
	6th, Ar. Communicans	
	7th, Ar. Palmaris Superficialis	1. Ri. Ascendentes 2. Ri. Descendentes vel Digitales

ARTERIES OF THE DESCENDING THORACIC AORTA.

Aorta Thoracica Descendens	1st, Ar. Bronchialis	1. Rs. Superior 2. Rs. Inferior
	2d, Ar. Œsophageæ	
	3d, Ar. Intercostales Inferiores, 8 or 9.	1. Ri. Spinales 2. Ri. Dorsales 3. Rs. Superior Costalis 4. Rs. Inferior Costalis

ARTERIES OF THE ABDOMINAL AORTA.

Arterial Trunks.	*Primary Branches.*		*Secondary Branches.*
Aorta Abdominalis	1st, Ar. Phrenica.		1. Rs. Dexter 2. Rs. Sinister
	2d, Ar. Cœliaca	Ar. Gastrica	1. Rs. Coronarius Superior 2. Rs. Coronarius Inferior
		Ar. Hepatica	1. Rs. Pyloricus Superior 2. Rs. Gastro-duodenalis *a* pancreatico-duodenalis *b* gastro-epiploica-dextra 3. Rs. Hepaticus Dexter *a* Cysticus 4. Rs. Hepaticus Sinister
		Ar. Splenica	1. Ri. Pancreatici Parvi 2. Rs. Pancreaticus Magnus 3. Vasa Brevia 4. Ri. Splenici 5. Rs. Gastro-epiploicus-Sinister
	3d, Ar. Mesenterica Superior		1. Ri. innominati 2. Rs. Colicus Medius 3. Rs. Colicus Dexter 4. Rs. Ileo-colicus
	4th, Ar. Supra-renales sive Capsulares		
	5th, Ar. Renales sive Emulgentes.		
	6th, Ar. Spermaticæ		
	7th, Ar. Mesenterica Inferior		1. Rs. Colicus Sinister 2. Rs. Sigmoideus 3. Rs. Hœmorrhoidalis Superior
	8th, Ar. Lumbales		1. Ri. Spinales 2. Ri Dorsales. 3. Ri. Abdominales
	9th, Ar. Sacri Med.		

ARTERIES OF THE LOWER EXTREMITIES.

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
Ar. Iliaca Communis		
Arteria Iliaca Interna	1st, Ar. Ilio-lumbales	1. Ri. Ascendentes 2. Ri. Transversi 3. Ri. Descendentes
	2d, Ar. Sacri Lateralis	1. Ri. Interni 2. Ri. Externi
	3d, Ar. Hœmorrhoidalis Media	
	4th, Ar. Vesicales	
	5th, Ar. Umbilicalis	
	6th, Ar. Glutea	1. Rs. Superficialis 2. Rs. Profundus
	7th, Ar. Ischiadica	1. Rs. Coccygeus 2. Comes Nervi Ischiadici 3. Ri. Musculares
	8th, Ar. Pudica Interna	1. Ri. Hœmorrhoidales Ext 2. Rs. Perinæus 3. Rs. Transversus Perinæi 4. Rs. Corporis Bulbosi 5. Rs. Corporis Cavernosi Penis 6. Rs. Dorsalis Penis
	9th, Ar. Obturatoria	1. Ri. Pelvici 2. Rs. Post. Cruris 3. Rs. Ant. Cruris
	10th, Ar. Uterina	
	11th, Ar. Vaginalis	
Arteria Iliaca Externa.	1st, Ar. Epigastrica	1. Ri. Spermatici 2. Ri. Abdominales 3. Ri. Anastomotici
	2d, Ar. Circumflexa Ilii	
Arteria Femoralis Communis	1st, Ar. Epigastrica Superficialis	
	2d, Ar. Pudicæ Externæ	
	3d, Ar. Circumflexa Ilii Superficialis	

Arterial Trunks.	*Primary Branches.*	*Secondary Branches.*
—	—	—
Arteria Femoralis Profunda	1st, Ar. Circumflexa Externa	1. Ri. Ascendentes 2. Ri. Circumflexi 3. Ri. Descendentes
	2d, Ar. Circumflexa Interna	
	3d, Ar. Perforans Prima	
	4th, Ar. Perforans Secunda	
	5th, Ar. Perforans Tertia	
Arteria Femoralis Superficialis	1st, Ar. Musculares	1. Ri. Superficiales 2. Ri. Profundi
	2d, Ar. Anastomotica Magna	
Arteria Poplitea	1st Ar. Articularis Superior Externa	1st, Ri. Superficiales 2d, Ri. Profundi
	2d, Ar. Articularis Superior Interna	
	3d, Ar. Articularis Media	
	4th, Ar. Articularis Inferior Externa	
	5th, Ar. Articularis Inferior Interna	
Arteria Tibialis Antica	1st, Ar. Recurrens	
	2d, Malleolaris Interna	
	3d, Ar. Malleolaris Externa	
	4th, Ar. Tarsi	
	5th, Ar. Metatarsi	
	6th, Ar. Dorsalis Pollicis	

Arterial Trunk.	*Primary Branches.*	*Secondary Branches.*
Arteria Tibialis Postica	1st, Ar. Peronæa	1. Rs. Anterior 2. Rs. Posterior
	2d, Ar. Nutritia Tibiæ	
	3d, Plantaris Interna	
	4th, Plantaris Externa	1. Ri. Perforantes. 2. Ri. Digitales.

DIVISION III.—THE VEINS.

The veins form a regular system of vessels, or membranous tubes, that return the blood from the branching extremities of the arteries to the *heart*. They resemble the arteries in their tubular form, and in containing and conveying blood, but are different from arterial vessels in many particulars.

The whole venous system of vessels may be compared to a tree, the root of which is connected with the heart, and the branches spreading out into all the textures of the body. In tracing the different parts of this system, in the direction of the current of the blood, we find the capillary ramifications forming a network in the substance of our organs, and returning the blood from the arteries. By the union of two or more of the smaller or capillary branches, a larger branch is formed; and these again in a similar manner unite to form larger, and so on in succession till the two venæ cavæ are formed, which terminate in the heart. The radicles of the veins thus unite in succession to form larger trunks; and as the sum of the area of the smaller vessels greatly exceeds that of the largest, the venous system, like the arterial, may be compared to a cone, the apex of which is concentrated in the heart, and the base included in the circumference of the body.

The form of the veins is cylindrical so long as they receive no new branch; but as every additional branch imparts an increase of size, they have the appearance of cones, although they are formed of a series of cylinders placed end to end, and successively increasing in diameter in the direction of the heart.

The *origin*, or branching extremities of the veins, is involved in the same obscurity as the *termination* of the arteries. It cannot be doubted that some of the veins arise from arteries, and some from lymphatics; and it is extremely probable that other origins exist; but the precise way in which they communicate with the veins, lymphatics, or other textures, cannot be condescended upon.

With certain exceptions veins *accompany* arteries; so that, generally speaking, for every artery there is an accompanying, and not unfrequently two accompanying veins. The following veins, however, have no such arteries:—1st, The subcutaneous veins—2d, The sinuses of the brain—3d, The vena cava superior—4th, The azygos vein—5th, The demi-azygos vein—6th, The vena hepatica. The following arteries have no accompanying veins: — 1st, The internal carotid — 2d, The spinous artery of the dura mater — 3d, The basilary artery.

The *course* of the veins is generally more rectilinear or less tortuous than that of the arteries; but their communications or inosculations are far more frequent.

According to Bichat, the venous tissue consists of three tunics —1st, an external or cellular—2d, a middle or proper tunic—and 3d, an internal. According to the same authority, the middle tunic consists of longitudinal fibres, and that it possesses both toughness and elasticity; still it must be admitted that in the sinuses no such tunic exists, and that in many of the other veins its existence is at best problematical. Two tunics, however, are always obvious—1st, an *external*, apparently formed of condensed cellular membrane, and varying in thickness in different veins of the body—2d, an *internal tunic*, which lines and polishes the former, and transmits processes inwards to form *valves*. This internal membrane is extremely thin and more distensible and less fragile than the corresponding tunic of the arteries. These tunics are plentifully supplied with vasa vasorum, and more sparingly with nerves. The *valves* are parabolic processes of the internal membrane of variable size. In each valve we find an adherent and a free margin, and two surfaces, a convex and a concave, so adapted as to offer no obstruction to the current of the blood in the direction of the heart, but easily thrown across the vessel like flood-gates by the refluent blood to oppose its further retrogradation.

Although *valves* appertain to the veins generally, yet they are not found in every vein. They are usually found in the following veins:—1st, Those of the *upper* and *lower extremities* —2d, Those of the *neck*—3d, Those of the *external parts* of the *head*—4th, The vena *azygos*—5th, The *spermatic* veins.

They are usually awanting in the following veins:—1st, The sinuses and veins of the brain—2d, Veins of the heart—3d, Veins of the abdominal viscera—4th, Veins of the womb and ovaries—and, 5th, according to Haller, in every vein less than a line in diameter.

I.—VEINS OF THE HEAD AND NECK.

1st, *Vena Jugularis Interna.*

Situation. Lateral part of the neck, immediately under the platysma myoides muscle. *Course.* Obliquely downwards and backwards, along the lateral anterior part of the neck, from the cervix of the lower jaw to the lower extremity of the sterno-mastoid muscle, at the posterior margin of which it opens into the subclavian vein. *Principal Branches.* 1st, temporalis superficialis—2d, maxillaris interna—3d, posterior auris—4th, transversalis colli—5th, supra scapularis.

2d, *Vena Jugularis Interna.*

Situation. Anterior part of the neck, at the external side of the common carotid artery. *Course.* Along the anterior surface of the rectus capitis anticus major, from the base of the cranium at the foramen lacerum posterius, to the subclavian vein into which it enters. *Principal Branches.* 1st, venæ cerebri—2d, venæ cerebelli—3d, vena ophthalmica—4th, venæ sinosæ duræ matris—5th, vena facialis—6th, vena lingualis—7th, vena pharyngea—8th, vena thyroidea superior—9th, vena occipitalis 10th, vena thyroidea media—11th, emissariæ Santorini.

II.—VEINS OF THE SUPERIOR EXTREMITY.

I.—SUBCUTANEOUS VEINS.

1st, *Vena Cephalica.*

Situation. Radial edge of the fore-arm and upper arm. *Course.* It commences upon the back of the hand, and runs upwards upon the outer side of the fore arm. At the bend of the elbow it receives the median cephalic, and continues its course along the external margin of the biceps, and between the deltoid and pectoralis major, till it gains the axillary vein. *Branches.* 1st, cephalica pollicis—2d, radialis superficialis.

2d, *Vena Basilica.*

Situation. Ulnar side of the anterior aspect of the fore-arm and upper arm. *Course.* From the back of the fingers and hand it ascends in one or two branches to the anterior part of the fold of the elbow; there it communicates with the median basilic; and thus reinforced, it mounts along the inner side of the upper arm, and is continued into the axillary vein. *Branches.* 1st, salvatella—2d, ulnaris anterior—3d, ulnaris posterior.

3d, *Vena Mediana.*

Situation. Middle of the anterior surface of the fore-arm. *Course.* Along the anterior surface of the fore-arm, from the palm of the hand and wrist, where it commences in numerous small branches, to the elbow, where it terminates by dividing into the mediana cephalica, the mediana basilica, branches which run respectively to the cephalic and basilic, and into the mediana profunda, which joins the deep veins.

II.—DEEP-SEATED VEINS.

1st, *Venæ Ulnares.*

Number. Two. *Situation and Course.* Same as ulnar artery with which they are in contact. *Branches.* Similar in number and name to the branches of the ulnar artery.

2d, *Venæ Radiales.*

Number. Two. *Situation and Course.* Same as radial artery with which they are in contact. *Branches.* Correspond with the branches of the radial artery.

3d, *Venæ Brachiales.*

Number. Usually two. *Situation and Course.* Same as the humeral artery which they are said to accompany, although the blood in the two sets of vessels moves in opposite directions. *Branches.* Correspond with the branches of the humeral artery.

4th, *Vena Axillaris.*

Situation.—Axilla. Course. It ascends from the upper extremity of the brachial veins, anterior to the axillary artery, as far as the first rib or inferior extremity of the scalenus anticus muscle, at which point it is continued into the subclavian vein. *Branches.* 1st, circumflexæ (anterior and posterior)—2d, subscapularis—3d, thoracicæ (3)—4th, thoracica acromialis.

4th, *Vena Subclavia (Dextra et Sinistra.)*

Situation. Lower part of the neck near the clavicle. *Course.* Across the lower part of the neck, from the external margin of the scalenus anticus muscle, anterior to which it passes, to the upper extremity of the vena cava. That part of the vein between the entrance of the internal jugular and vena cava being called also *vena innominata. Branches.* 1st, jugularis externa—2d, vertebralis—3d, intercostalis superior—4th, jugularis interna. The *left* subclavian receives also the following—mammaria sinistra, and thyroidea inferior sinistra.

III.—VEINS OF THE THORAX.

1st, *Vena Cava Superior.*

Situation. Right side of the thorax. *Course.* From the junction of the two venæ innominatæ, which is usually opposite the cartilage of the first rib, obliquely downwards, forwards, and to the left as far as the right auricle of the heart, into the posterior superior part of which it enters, and in its course receives the following *Branches:*—1st, thyroidea inferior (dextra)—2d, mammaria dextra — 3d, thymicæ — 4th, mediastinales — 5th, pericardiacæ—6th, azygos, which receives the demi-azygos—7th, diaphragmatica superior.

2d, *Venæ Pulmonales.*

Number. Four, two to each lung. *Situation.* In the thorax, betwixt the lungs and heart. *Course.* They arise from the terminations of the pulmonary artery in the tissue of the lungs—leave the cardiac surface of these organs, and penetrating the pericardium, open into the posterior part of the left auricle of the heart. *Uses.* These veins have a use essentially different from the other veins. They carry pure or arterial blood to the heart to be afterwards transmitted over the system for the purposes of nutrition.

3d, *Venæ Cordis.*

Number. Two, which arise from the right and left sides of the heart, and concur in forming a single trunk that opens into the right auricle of the same organ, the orifice of which is protected by a valve.

IV.—VEINS OF THE INFERIOR EXTREMITY.

I.—CUTANEOUS VEINS.

1st, *Vena Saphena Magna vel Interna.*

Situation. Anterior and internal side of the leg and thigh. *Course.* It commences upon the back of the foot, ascends to the leg by the inner margin of the internal malleolar process of the tibia, and continues upwards along the inner part of the leg, knee, and thigh. At two inches from Poupart's ligament, it passes over the lower horn of the falciform process of the fascia lata, and unites with the femoral vein, and receives in its course the following *Branches:*—1st, Epigastrica Externa—2d, Circumflexa Ilii Superf.—3d, Pudicæ Externæ.

2d, *Vena Saphena Parva vel Externa.*

Situation. Posterior part of the leg. *Course.* From the external part of the dorsum of the foot, it passes behind the external malleolar process, and ascends obliquely to the mesial line of the gastrocnemius muscle, along which it runs till it passes between the origins of that muscle, when it gets into the ham, and opens into the popliteal vein.

II.—DEEP-SEATED VEINS.

1st, *Venæ Tibiales Posticæ.*

Number. Two. Course and ramifications same as Posterior Tibial Artery.

2d, *Venæ Tibiales Anticæ.*

Number. Two. Course and Branches same as Anterior Tibial Artery.

3d, *Vena Poplitea.*

Situation. Popliteal space. *Course.* Continued from the anterior and posterior tibial veins, it ascends, in company with the popliteal artery, to the upper extremity of the canal in the triceps muscles, when it becomes the femoral vein, receiving in its course the following *Branches:* 1st, saphena parva—2d, articulares, which correspond with the articular arteries.

4th, *Vena Femoralis.*

Situation. Anterior and inner part of the thigh. *Course.* Obliquely upwards and inwards, from the popliteal space to the crural arch, close to the femoral artery. *Branches.* 1st, profunda femoris—2d, circumflexa externa—3d, circumflexa interna—4th, vena saphena magna.

Vena Iliaca Externa.

Situation. Within the abdomen along the artery of the same name, and at the inner margin of the psoas magnus muscle. *Course.* Continued from the femoral vein—it extends upwards and inwards for about three inches, when it unites with the internal iliac, to form the common iliac vein. *Branches.* 1st, circumflexa ilii interna—2d, epigastrica.

Vena Iliaca Interna.

Situation. Within the pelvis, anterior to the sacro-iliac symphysis, and behind the artery of the same name. *Branches.* 1st, vesicales—2d, hæmorrhoidalis media—3d, ischiadica—4th, pudica interna—5th, glutea—6th, obturatoria—7th, ilio-lumbalis—8th, sacri lateralis; and in the female—9th, uterina—10th, vaginalis.

Vena Iliaca Communis (Dextra et Sinistra).

Formed by the junction of the external and internal iliac veins—they proceed obliquely upwards and inwards to the articulation of the fourth and fifth lumbar vertebræ, when they unite to form the commencement of the vena cava inferior. *Differences of course and relationship on the right and left sides.*

V.—VEINS OF THE ABDOMEN.

Vena Cava Inferior.

Extends from the junction of the fourth and fifth lumbar vertebræ on the right side of the aorta, to the right auricle of the heart into the posterior inferior part of which it enters. *Branches.* 1st, sacri media—2d, lumbales—3d, spermaticæ—4th, renales—5th, capsulares—6th, hepaticæ—7th, diaphragmaticæ, which, with the exception of the 6th, take the course of the corresponding arteries.

Vena Portæ.

Origin. By numerous roots from the chylo-poietic viscera. *Course.* Its roots concur in forming *two* large venous *trunks*, which unite and enter the transverse fissure of the liver, then divide into two great branches, one for the right and the other for the left grand division of the liver; these branches again subdividing like the ramifications of an artery till they are lost upon the lobules of the liver. They carry blood for the secretion of the bile.

These trunks are:—

1. *Vena Splenica.*—*Origin.* From the spleen, and left half of the great intestines. *Course.* Along the splenic artery to the superior mesenteric vein with which it unites. *Branches.* 1st, venæ breviores—2d, gastro-epiploica dextra et sinistra—3d, duodenalis—4th, pancreaticæ—5th, coronaria ventriculi.

2. *Vena Mesenterica Superior.*—*Origin.* From the small intestines and right half of the colon. *Course.* Same as the corresponding artery. *Branches.* 1st, ilio-colica—2d, colica dextra—3d, colica media—4th, mesentericæ.

Sinus Vertebrales.

Situation. Vertebral canal. *Number.* Two, one on each margin of the posterior common vertebral ligament. *Course.* From the inferior extremity of the sacrum along the posterior surface of the bodies of the vertebræ to the base of the cranium, where they communicate with the internal jugular veins of the same side. Transverse sinuses stretch across the bodies of the vertebræ, and connect the longitudinal sinuses together.

TABLE OF THE VEINS.

DIVISION I.—VEINS OF THE HEAD AND NECK.

VEINS THAT UNITE IN FORMING THE EXTERNAL JUGULAR.

Secondary Branches.	*Principal Branches.*	*Venous Trunks.*
1. Ri. superiores 2. Ri. temporales med. 3. Ri. anteriores auris 4. Rs. transversalis faciei 5. Ri. articulares	1st, Va. temporalis superficialis	Vena jugularis externa
1. Ri. pterygoidei 2. Ri. temporales profundi 3. Rs. spheno-palatinus 4. Rs. infra orbitalis 5. Ri. alveolares 6. Rs. mentalis	2d, Va. maxillaris interna	
1. Rs. posterior 2. Rs. auricularis post. 3. Rs. stylo-mastoideus	3d, Va. post. auris	
1. Ri. cervicales superf. 2. Rs. scapularis post.	4th, Va. transversalis cervicis	
1. Rs. supra spinatus 2. Rs. infra spinatus	5th, Va. transversalis humeri	

VEINS THAT CONCUR IN FORMING THE INTERNAL JUGULAR:

1st, Those that arise from parts within the Cranium and Orbit, and terminate in Sinuses of the Dura Mater.

	1st, Væ. cerebri sup.	Vena jugularis interna
1. Rs. corporiis striati 2. Rs. plexus choroidis	2d, Va. Galeni	
	3d, Væ. cerebelli	

Secondary Branches.	*Principal Branches.*
1. Rs. lachrymalis 2. Rs. centralis retinæ 3. Rs. infra orbitalis 4. Ri. ciliares 5. Ri. choroides 6. Ri. ethmoidales 7. Ri. palpebrarum 8. Ri. nasales	4th, Va. ophthalmica

2d, *Sinuses of the Dura Mater terminating directly or indirectly in the Jugular Vein.*

The veins which enter these sinuses:		
Væ. cerebri sup.	1st, sinus longitudinalis superior	
	2d, sinus longitudinalis inferior	
Væ. cerebelli, &c.	3d, sinus lateralis, dextra et sinistra.	
Væ. Galeni	4th, sinus rectus	
	5th, torcular Herophili	
Va. ophthalmica	6th, sinus cavernosus	Vena jugularis interna
	7th, sinus circularis	
	8th, sinus superior petrosus	
	9th, sinus inferior petrosus	
Væ. cerebelli	10th, sinus occipitalis posterior	
	11th, sinus occipitalis Anterior	

3d, *Veins that arise from parts exterior to the Brain, and terminate in the Internal Jugular Vein.*

1. Ri. frontales 2. Ri. superaorbitalis 3. Ri. dorsales nasi 4. Rs. coronarius sup. 5. Rs. coronarius inf. 6. Ri. buccales 7. Ri. masseterici 8. Rs. raninus 9. Rs. submentalis 10. Ri. palatini inferiores	1st. Va. facialis.

Secondary Branches.	*Principal Branches.*	*Venous Trunks.*
1. Rs. sublingualis	2d, Va. lingualis	Vena jugularis interna.
	3d, Va. pharyngea	
2. Ri. thyroidei 3. Ri. laryngei	4th, Va. thyroidea superior	
	5th, Va. occipitalis.	
	6th, Væ. emissariæ Santorini	

DIVISION II.—VEINS OF THE SUPERIOR EXTREMITIES.

VEINS THAT CONCUR IN FORMING THE AXILLARY:

1st, *Superficial Veins.*

1. Rs. cephalicus pollicis 2. Rs. radialis superf.	1st, Va. cephalica	Vena axillaris
1. Rs. salvatellus 2. Rs. ulnaris ant. 3. Rs. ulnaris post.	2d, Va. basilica	
	3d, Va. mediana	
	4th, Va. mediana cephalica	
	5th, Va. mediana basilica	

2d, *Deep-seated Veins.*

Secondary branches, small, and correspond with the secondary ramifications of the axillary artery	1st, Væ. ulnares	
	2d, Væ. radiales	
	3d, Væ. brachiales	
	4th, Væ. circumflexæ	
	5th, Va. subscapularis	
	6th, Va. thoracicæ (3)	
	7th, Va. Thoracica acromialis	

VEINS THAT CONCUR IN FORMING THE SUBCLAVIAN.

Secondary Branches.	*Principal Branches.*	*Venous Trunks.*
	1st, Va. jugularis externa	Vena subclavia
	2d, Va. vertebralis	
. Rs. bronchialis sinister	3d, Va. intercostalis superior	
	4th, Va. jugularis interna	
On the left side, the following also concur:		
	5th, Va. mammaria	
	6th, Va. thyroidea inferior	

DIVISION III.—VEINS OF THE THORAX.

	1st, Va. thyroidea inferior dextra	vena cava sup.
	2d, Va. mammaria dextra	
	3d, Væ. thymicæ.	
	4th, Væ. mediastinales	
	5th, Ri. pericardiaci	
	6th, Ri. diaphragmatici superiores	
1. Rs. Bronchialis, dexter. 2. Rs. demiazygos		
		Venæ pulmonicæ (4)
		Vena cordis

DIVISION IV.—VEINS OF THE INFERIOR EXTREMITY.

	1st, Va. saphena, posterior v. parva	Vena poplitea
Ri. peronei	2d, Væ. tibiales anticæ	
	3d, Væ. tibiales posticæ	
	4th, Væ. articulares (5)	

Secondary Branches.	*Principal Branches.*	*Venous Trunks.*
Ri. perforantes	1st, Va. profunda femoris	Vena femoralis
	2d, Va. circumflexa externa	
	3d, Va. circumflexa interna	
1. Rs. Epigastricus superf. 2. Rs. circumfl. ilii superf. 3. Ri. pudici externi	4th, Va. saphena magna	
	1st, Va. epigastrica	Vena iliaca externa
	2d, Va. circumflexa Ilii	
	1st, Va. pudica communis	Vena iliaca interna, vel hypogastrica
	2d, Va. ischiadica	
	3d, Va. obturatoria	
1. Rs. dorsalis penis, vel, Rs. dorsalis clitoridis	4th, Va. vesicalis	
	5th, Va. hæmorrhoidalis med.	
	6th, Va. glutea	
	7th, Va. sacri lateralis	
	8th, Va. ilio-lumbalis	
	AND IN THE FEMALE,	
	9th, Va. uterina	
	10th, Va. vaginalis	
		Vena iliaca communis dextra et sinistra

DIVISION V.—VEINS OF THE ABDOMEN.

	1st, Va. sacri med.	Vena cava inferior
1. Rs. dorsalis 2. Rs. Abdominalis	2d, Væ. lumbales	
Corpus Pampiniforme......	3d, Væ. spermaticæ	
	4th, Væ. renales	
	5th, Væ. capsulares	
	6th, Væ. hepaticæ	
	7th, Væ. diaphragmaticæ	

Secondary Branches.	*Principal Branches.*	*Venous Trunks.*
1. Rs. mesentericus inf. 2. Rs. coronarius ventriculi 3. Ri. duodenales 4. Ri pancreatici 5. Rs. gastro-epiploicus dexter 6. Rs. gastro-epiploicus sinister	1st, Va. splenica	Vena portæ
1. Ri. mesenterici 2. Rs. ilio-colicus 3. Rs. colicus dexter 4. Rs. colicus medius	2d, Va. mesenterica superior	
		Sinus vertebrales.

THE BLOOD.

Blood is found, in the living state, in all the cavities of the apparatus of the circulation, and in two conditions—1st, that of *venous*—and 2d, that of *arterial* blood. The first, of a modena or purple hue, exists in the systemic veins, in the right auricle and ventricle of the heart, and in the pulmonary artery: the second, of a florid vermilion colour, is confined to the *pulmonary veins*, left auricle and ventricle of the heart, and systemic arteries.

The quantity of blood in man has been variously estimated: by Allen and Mullen at little more than 8 pounds; by Harvey at 9; by Borelli at 20; by Haller at 30; by Riolan at 40; by Hamberger at 80; and by Keil at 100—differences which demonstrate the difficulty of arriving at any just or satisfactory conclusion upon the subject.

When flowing from the blood-vessel of a living human subject, it appears to be a fluid of a homogeneous quality, of a red colour, of a viscid consistency, and of a peculiar fleshy odour. When seen moving in the capillary vessels of a living animal, it appears like globules swimming in a transparent medium. When drawn off from the body, it soon loses its homogeneous appearance, and separates into two parts; one of which assumes the solid form—the *clot* or *crassamentum;* and the other, which remains fluid, is yellowish and transparent, and usually called the *serum* of the blood.

The *crassamentum* consists of *two* parts essentially distinct—1st, of extremely minute particles—the *globules* of the blood; and 2d, of fibrine—a peculiar substance bearing some resemblance to muscular fibre, and on which the coagulation of the blood depends.

The *serum*, by the application of heat, is resolvable also into *two* parts—1st, into a concrete portion—albumen; and 2d, into a fluid that remains uncoagulated, and which drains off from the albumen, and called the *serosity* of the blood.

In the human subject, the red particles are not *globules*, but *circular flattened disks* of about 1-4000th part of an inch in diameter, and each composed of an external envelope from which the colour of the blood is derived, and of a central colourless *nucleus*, less soluble than the envelope.

Analysis of the Blood by M. Le Canu.

In every thousandth part there are—

Water	786·590
Fibrin	3·565
Albumen	69·415
Colouring matter	119·626
Crystalisable fatty matter	4·300
Oily matter	2·270
Extractive matter soluble in alcohol and water	1·920
Albumen, combined with soda	2·010
Chloruret of sodium and potassium, alkaline phosphate, sulphate, and subcarbonates	7·304
Subcarbonate of lime and magnesia, phosphate of lime, magnesia, and iron, peroxide of iron	1·414
Loss	2·586
	1000·000

When newly drawn blood is placed in the vacuum of an air-pump, or coagulates in the air, or is received as it flows from the vein into pure hydrogen, it emits a quantity of carbonic acid gas.

The blood in the living subject displays also physiological properties of a highly interesting nature, by which life is maintained, the growth of the system promoted, and the energy of every part upheld—properties that depend upon the *vitality* which the blood itself enjoys, and not simply upon the peculiarities of its physical or chemical elements. This fluid, by the incessant action of the heart, is transmitted uninterruptedly and in a circular current to all the parts of the body, and throughout its course leaving in every part an impress of vitality. This movement of the blood from the heart through the arteries, and by the veins to the heart again, called its *circulation*,* was discovered by William Harvey in 1619 or 20—a discovery which has immortalised its author—which has done honour to the science of this country, and benefited the whole human race, by the stable foundations it has prepared for the superstructure of medical science.

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* In man, the *circulation* is double—consising of the *lesser* and *greater* circulation: the lesser circulation, or that through the vessels of the *lungs*, and the greater through the vessels of the *system*. The lesser circulation was suspected to exist by Servetus, Colombus, and Cesalpinus, but by Harvey, the circulation of the blood throughout its whole course was *demonstrated*, and proved by experiment. Harvey showed that the blood moved from the left side of the heart through the arteries; and is returned by the veins to the right cavities of the same organ; that it passed thence through the pulmonary artery, and returned by the pulmonary veins to the left chambers of the heart, or to the point whence it set out in the circle.

Peculiarities of the apparatus of the circulation in the Fœtus.

These peculiarities have a reference principally to the *placental circulation* which exists during fœtal life, and which terminates at birth. They are the following—1st, The *foramen ovale* or opening in the *septum* of the auricles by which the two auricular cavities communicate. 2d, The *ductus arteriosus*, or arterial inosculation between the pulmonary artery and descending part of the arch of the aorta. 3d, The *two umbilical arteries* that proceed from the internal iliacs or hypo-gastrics to the placenta, upon which they ramify. 4th, The *umbilical vein* that commences by numerous radicles in the placenta, extends through the umbilicus of the child, ramifies partly in the liver, and by means of, 5th, The *ductus venosus*, transmits the blood to the right auricle of the heart.

PART VII.

ORGANS OF RESPIRATION AND VOICE.

I.—ORGANS OF RESPIRATION.

These organs may be simply arranged into two classes—1st, *External* organs, chiefly concerned in the mechanical acts of respiration; and 2d, *Internal* organs, those on which the vital phenomena of respiration depend, or in which the blood is oxygenated and decarbonised, and fitted for nutrition. The first class, or *external* organs, comprehends the *thorax*, which consists of—

1. *Bones:*—Twelve dorsal vertebræ, twelve ribs on each side, and the sternum.

2. *Cartilages:*—Those that eke out and connect the ribs to the sternum and to each other.

3. *Muscles:*—The principal of which are the diaphragm and intercostal, although every muscle attached in any way to the chest assists in the process.

4. *Arteries:*—Branches of the subclavian:—axillary:—descending thoracic:—and of the abdominal aorta.

5. *Veins:*—Branches of the axillary:—subclavian:—superior vena cava:—vena azygos:—demi-azygos:—and inferior vena cava.

6. *Lymphatics:*—Superficial and deep-seated.

7. *Nerves:*—From superficial cervical plexus, from brachial plexus, and the dorsal nerves.

8. *Cellular Membrane*, uniting all the textures.

9. *Skin*, which varies in thickness on different parts of the chest.

10. *Pleura Costalis:*—A portion of the pleura which lines and smooths off the inner surface of the chest.

THE LUNGS.

Two spongy cellulous organs, situated within the thorax, separated by the mediastinum, and communicating with the atmosphere by the windpipe. *Form.* Each an irregular cone flattened internally, the *base* of which rests upon the diaphragm, and the *apex* in contact with the first rib, or even rising above it; the right lung larger than the left, and consisting of three lobes—the left lung of two lobes only. *Volume.* Corresponding with the size of the peural cavities, which they exactly fill. *Weight.* After respiration has been established, *lighter* than water; but previous to birth of greater specific gravity than that fluid. *Structure.* 1st, trachea—2d, bronchial tubes—3d, bronchial or pulmonic cells—4th, interstitial cellular membrane—5th, arteries—6th, veins—7th, lymphatics—8th, nerves—9th, internal mucous membrane—10th, pleura.

1. *Trachea.* A fibro-cartilaginous and musculo-membranous tube flattened posteriorly, which stretches from the larynx to the second or third dorsal vertebra, where it divides into the right and left *bronchus.* *Structure.* 1st, *fibro-cartilaginous rings* or *arches*, which vary in number from fifteen to twenty, defective in their posterior third, developed in a *fibrous membrane*, which covers them anteriorly, connects them together, and ekes out the posterior third of the circle—2d, *tracheal glands*—3d, *muscular fibres*—4th, *mucous lining membrane*, that adheres to the muscular fibres posteriorly, and to the cartilaginous rings anteriorly—5th, *cellular substance*—6th, *arteries*, branches of the superior and inferior thyroid—7th, *veins* which correspond with the arteries—8th, *lymphatics*, that pass through the glandulæ concatenatæ—9th, *nerves* from pneumogastric; and cervical ganglia of the great sympathetic.

2. *Bronchi.* Continuations of the trachea, presenting the same structure: the fibro-cartilaginous rings are thinner and smaller, and ultimately disappear in the lungs. The right bronchus is wider, shorter, and more horizontal than the left, and bearing also different relations.

3. *Bronchial Cells.* The bronchial tubes which ramify ad infinitum like the branches of an artery, terminate in small *cul de sacs* or cells, into which the air penetrates; a number of these cells, united by the interstitial cellular membrane, constitutes a pulmonary lobule. These *lobules* are distinct even at the exterior of the lungs, and are separated by whitish grooves. By the union of these *lobules*, the *lobes* are formed, and by the union of the lobes the whole lung results.

4. *The Interstitial Cellular Membrane* is peculiarly delicate, contains no fat, connects the bronchial cells together, and forms a vehicle for the ramifying textures.

5. *The Ramifying Textures* of the lungs are, 1st, the pulmonary artery—2d, the pulmonary vein—3d, the bronchial arteries—4th, the bronchial veins—5th, nerves from the pulmonic plexus.

6. *Lymphatics and Bronchial Glands.*—The lymphatics of the

lungs are of two kinds, superficial and deep-seated, and pass through the *Bronchial glands:*—Lymphatic ganglia of a black colour, situated before the bifurcation of the trachea, and around the bronchia into the substance of the lungs.

7th, *Internal Mucous Membrane*—can be easily traced from the fauces down the trachea to the inferior extremities of the bronchi; but it still remains doubtful whether it lines the bronchial cells.

7th, *Pleura.* The great serous membrane of the thoracic cavity, consisting of two parts or bags, each of which is a shut sac, one part of which lines the inside of the thorax—*pleura costalis*—and another—*pleura pulmonalis*—covers the lungs. These two bags tend to meet in the mesial line of the thorax; but from the existence of the heart and other parts in that situation they do not touch. They form, however, by their approximation, the *mediastinum*, a septum that stretches from the spine to the sternum, and separates completely the lungs. The space betwixt the two *laminæ* of the *mediastinum* has been viewed as consisting of three parts. 1st, *an anterior mediastinal space*, inclosing thymus gland and lymphatic ganglia—2d, *a middle mediastinal space*, inclosing heart and pericardium—3d, *posterior mediastinal space* lodging the inferior extremity of the trachea and commencement of the bronchial tubes, the aorta, vena azygos, thoracic duct, œsophagus, with its accompanying nerves and lymphatic ganglia.

II.—ORGAN OF VOICE, OR LARYNX.

Situation. In the mesial line of the neck, at the upper part of the trachea, of which it constitutes the top, adapted for transmitting the air to and from the lungs, and modifying it so as to constitute *voice.*

The organ consists of the following textures:

1. *Cartilages.* See page 59.
2. *Muscles.* See page 60.
3. *Ligaments.* See page 60. The most important of these are the two thyro-arytenoid or *vocal cords*, to which all the other textures have directly or indirectly a reference. These ligaments, formed of dense and elastic fibres, and about two lines in breadth, stretch from the anterior part of the base of the arytenoid cartilages to the retiring angle of the thyroid, and thus form the lateral boundaries of the *rima glottidis*, or opening into the windpipe—a chink, the relations of which to the ventricles of the larynx or lateral depressions situated immediately above them:—to the upper rings of the trachea, and to the crico-thyroid space, should be particularly observed by the student.

4. *Glands.* These are the epiglottidean and arytenoidean, so called from their situation. The epiglottidean is situated behind the body of the os hyoides and on the lingual aspect of the epiglottis, and opens by numerous apertures on the laryngeal surface of that cartilage. The arytenoidean are denser follicles than the former, arranged into the form of the letter L near the anterior part of the arytenoid cartilages and pour their fluids upon the mucous membrane.

5. *Mucous Membrane.* Extending backwards from the tongue and from the pharynx, covers and adheres to every projection, and lines every cavity, and descends into the trachea.

6. *Cellular Membrane.*

7. *Arteries.* Branches of the superior and inferior thyroid.

8. *Veins.* The thyroid.

9. *Lymphatics.*

10. *Nerves.* Superior and inferior laryngeal branches of the pneumo-gastric.

PART VIII.

ORGANS OF SECRETION.

THESE organs are scattered to a great degree over the body, and present much apparent diversity of structure. They may be arranged into four classes :—1st, the vesicular ; 2d, the cellular ; 3d, the membranous ; and, 4th, the glandular.

I. The *vesicular* organs of secretion are found, 1st, in the ovaries, and consist of small vesicles, like millet-seeds, that secrete an albuminous fluid, in which the ova are developed—2d, probably the sacculi solitarii and agminati, or Peyer's glands, situated in the small intestines.

II. The *cellular* organs of secretion are found under a two-fold modification—1st, the sero-cellular—and, 2d, the adiposo-cellular. The first secrete the fluid found in the cellular textures generally of the body, and the second the adipose matter, deposited so plentifully in almost every part of the body.

III. The *membranous* organs of secretion are of four kinds—1st, the *serous*, shut sacks that secrete a fluid like the serum of the blood, to obviate the friction of opposing surfaces—2d, *the synovial*, similar in many respects to the serous, but secreting lubricating fluids for the interior of *the joints* only—3d, *the mucous*, that line the interior of canals and organs that communicate with the atmospheric air, or with the skin, at the natural apertures of the body, and that secrete a mucous fluid that lubricates the internal surfaces of various organs and conduces, to many important purposes in the economy—4th, the *cutaneous*, or the skin, the secretions of which are numerous, some taking the *solid* form, as the cuticle, hairs, and nails, and others remaining fluid, as the perspiration, which is effused, not from the orifices of blood-vessels, but from the sebaceous follicles of the hairs and perspiratory follicles, or glands—the *cuticular* secretion is thrown out from the surface generally of the skin, and each of the other cutaneous secretions is formed by a distinct apparatus of a follicular or glandular structure.

IV. The *glandular* organs of secretion exist, under some few modifications, of internal structure, and under many of external form. They all secrete fluids, highly elaborated, and conducive to many purposes *general*, as well as *special*, in the economy.

A gland is essentially a *secreting tube*, one extremity of which terminates in a blind sac, and the other opens upon a mucous or cutaneous surface. This tube or gland is found under four modifications: 1st, a simple cæcal tube, or shallow cup—like depression in a mucous membrane (*a crypt*)—2d, a cæcal tube, or crypt, more elongated than the former, and terminating by a contracted aperture (*a simple follicle*)—3d, follicles may be clustered together so as to open each by a distinct orifice: or small follicles may cluster round and terminate in a larger one, which alone opens directly upon the mucous membrane—thus forming two kinds of *compound follicles*—4th, In the *proper glands*, the cæcal tubes are much elongated, and may exist either in a ramified or a non-ramified, or simply tubular form; the first, including the lachrymal gland, the salivary glands, pancreas, liver, and mammæ, and the second, the kidneys and testes,

List of the Proper Glands.

1. *Lachrymal Gland.—Situation.* Lachrymal fossa of the orbitary plate of the frontal bone, and superior and external part of the globe of the eye. *Form.* Oval about the size of an almond; convex superiorly, concave inferiorly, and elongated from behind forwards.

Structure. Formed of a congeries of small rounded lobules, connected by cellular membrane, and supplied by,

1st, The lachrymal branch of the ophthalmic *artery*.

2d, *Veins*, which pour their blood into the ophthalmic vein.

3d, *Lymphatics.* Probably pass out to the face by the base of the orbit.

4th, *Nerves.* Lachrymal branch of the ophthalmic division of the trifacial.

5th, *Excreting Ducts.* These ducts branch into numerous tufts in the interior of the lobules, each tuft terminating in a small cell. In extending from the lobules, the branches unite so as to form seven canals, that open upon the tunica conjunctiva at the superior and external part of the upper eyelid.

6th, Fibro-cellular envelope, of considerable density, which not only surrounds the gland, but dips into its interior.

7th, *Use.* To secrete the tears.

2d, Salivary Glands, the two parotid, the two submaxillary, and the two sublingual. (See page 129.)

3d, Liver. See page 133.

4th, Pancreas. See page 133.

5th, Mammæ See Generative Organs.

6th, Testes. See Generative Organs.

7th, Kidneys. See Urinary Organs.

URINARY ORGANS.

These organs may be arranged into the glandular and membranous.

The *glandular* urinary organs consist of the kidneys, and the *membranous*, include the ureters and urinary bladder.

1. *The Kidneys.*

Number. Usually two, one on each side. *Situation.* Deeply in the lumbar region on the sides of the spine, and behind the peritoneum. *Form.* Ovoidal, flattened from before backwards, and notched on its inner or mesial margin, and presents *two surfaces*, an anterior and a posterior; *two margins*, an internal or concave, and an external or convex; and *two extremities*, a superior and an inferior. *Colour.* Brownish. If the kidney be cleft into two, commencing the incision along the convex margin, three very different and fundamental textures will be exposed, the vascular, the tubular, and the membranous.

1. The *vascular* forms what is usually denominated the *cortical* part—an external layer about two or three lines in thickness, which surrounds the organ, and extends also inwards, between the tubular cones.

2. The *tubular* part, which consists of delicate canals, so arranged as to constitute distinct cones, the *bases* of which are turned to the periphery of the kidney; and the *apices*, called *mammillary processes*, which are free, to the pelvis of the organ, and present exceedingly small orifices.

3. The *membranous* textures of the kidney are of two kinds —1st, the internal—and 2d, the external. The *internal membranes* constitute an apparatus for receiving the urine from the tubular. That apparatus consists of two parts—the *calyces* or *infundibula* and the *pelvis.* The *calyces* or *infundibula* are canals which embrace the mammillary processes by one of their extremities, and open by their other extremity into the pelvis of the kidney. Their number usually corresponds with that of the mammillary processes, which vary from twelve to

eighteen, although two or more of these processes are sometimes found surrounded by a single calyx.

The *pelvis* of the kidney is a membranous bag which occupies the posterior part of the renal fissure—elongated from above downwards, somewhat oval in its form, and communicating with the infundibula on the one hand, and with the ureter, with which it is continuous, on the other.

The *external membrane* or envelope. Thin, fibrous, and easily detached from the kidney, covering completely the organ.

4. The *Ramifying Textures.* The renal artery, renal vein, nerves from little splanchnic and solar plexus.

5. *Lymphatics*, which issue from the pelvis, and pass through the lumbar ganglia.

6. *Cellular Membrane.* Condensed upon the exterior of the infundibula, enclosing fat.

7. *Use.* To secrete the urine.

According to Berzelius, 1000 parts of the urine are composed of

Water,	933·00
Urea,	30·10
Uric acid,	1·00
Free lactic acid, lactate of ammonia, and animal matter not separable from them,	17·14
Mucus of the bladder,	0·32
Sulphate of potassa,	3·71
Sulphate of soda,	3·16
Phosphate of soda,	2·94
Phosphate of ammonia,	1·65
Muriate of soda,	4·45
Muriate of ammonia,	1·50
Earthy matters, with a trace of the fluate of lime,	1·00
Siliceous earth,	0·03

2. *The Ureter.*

A tube about the size of a crow quill, that connects the interior of the pelvis of the kidney with the interior of the urinary bladder, and is related to the abdomen, the pelvis, and the walls of the bladder. *Structure.* 1st, *external tunic*, dense and thick—2d, *internal mucous membrane*, which extends into the pelvis of the kidney and calyces, covers the mammillated processes, and lines probably the uriniferous ducts—3d, ramifying textures—4th, *Use.* To transmit the urine from the kidney to the bladder.

3. *The Bladder.*

Situation. In the pelvis immediately behind the pubes. *Form.* Conical, sometimes ovoidal or cylindrical, but varying with the periods of life. *External Surface:—Superior Fundus:* Partially covered by peritoneum, and transmitting a fibrous cord, *the urachus*, which stretches to the umbilicus. *Inferior Fundus:* Differently related in the two sexes. *Anterior Region:* Uncovered with peritoneum, and connected by loose cellular membrane to the pubes, and by the *anterior ligament* of the bladder. *Posterior Region:*—Entirely covered by peritoneum—the reflection of which membrane from this surface is usually called the posterior ligament of the bladder. *Lateral Region:* Narrower above than below, *superiorly* in relation with peritoneum, *inferiorly* with much loose cellular membrane, vasa deferentia, and blood vessels. *Neck of the Bladder:*—At the base of the prostate gland.

Internal Surface:—Presenting, 1st, the orifice of the *urethra*—2d, the orifices of the *ureters*—3d, uvula vesicæ—4th, trigonal space.

Structure:—1st, serous tunic—2d, muscular coat—3d, mucous membrane—4th, mucous follicles—5th, the ramifying texture—6th, lymphatics—7th, cellular membrane. *Use:*—A reservoir for the urine.

Non-Secreting Glands, or Ganglia.

The non-secreting glands of many anatomists are here excluded from the list of glandular bodies: they are not glands, but *ganglia*, and are of two kinds, 1st, the *vascular*—and, 2d, the *lymphatic ganglia:* the first include the thyroid and thymus bodies; the supra renal capsules, and the placenta; and the second, the lymphatic and mesenteric ganglia.

1. *Vascular Ganglia.*

1. *Thyroid Ganglion* or *Gland. Situation.* Front of the neck stretching across the lower part of the larynx and upper part of the trachea. *Form.* Narrow in the mesial line of the neck, and more bulging at the sides, and consisting of a middle part or isthmus, and two lateral lobes, one on each side, and covered by the skin, platysma myoides, fascia, sterno-hyoid, sterno-thyroid, omo-hyoid, and sterno-cleido mastoid muscles. *Structure.* Appears to consist of small cells, connected by cellular membrane, and supplied by arteries, veins, lymphatics, nerves,—1st, *Arteries:* usually four, the two superior thyroid, branches of the external carotid: and the two inferior thyroid, branches of the subclavian—2d, *Veins:* often numerous, that issue from the lower part of the gland, and terminate in the internal jugular—3d, *lymphatics*, that pass through the glandulæ concatenatæ—4th, *Nerves*, from the pneumo-gastric and cervical ganglia of the great sympathetic. *Use.* Unknown.

2. *Thymus Ganglion*, or *Gland.—Situation.* Anterior mediastinal space, and in the fœtus, stretching from near the diaphragm to the thyroid gland. In the adult, it is scarcely to be found. *Structure.* It consists of lobules, presenting internally vesicles, which communicate with a reservoir, and filled with a viscous fluid. The lobules are connected by a loose cellular substance, and supplied by arteries, veins, lymphatics, nerves —1st, *Arteries:* branches of the internal mammary inferior thyriod, bronchial, mediastinal, and pericardiac—2d, *Veins*, corresponding with the arteries—3d, *Lymphatics.* According to Sir Astley Cooper, a large lymphatic issues from each of the two superior cornua of the gland, and terminate at the upper part of the superior vena cava—4th, *Nerves:* branches of the pneumo-gastric, phrenic, and inferior cervical ganglia of the great sympathetic. *Use.* Unknown.

Fluid of the Thymus.

Physical Properties. Whitish, slightly viscous, and containing microscopic white particles.

Chemical Properties. Coagulable by heat, alcohol and mineral acids; and according to Mueller, consisting of the following *saline* ingredients: muriate and phosphate of potash and soda, with a trace of phosphoric acid.

3. *Supra-renal Capsules.—Number.* Two, one on each side. *Situation.* Upper extremity of the kidneys which they embrace. *Form.* Prismatic and triangular. *Colour.* Yellowish brown. *Structure.* A species of bag, the walls of which are thick compared with the size of the internal cavity, and formed of numerous soft granules, which are connected into lobules, and by the union of these lobules the walls are formed; all the ramifying textures likewise enter into its formation. The internal cavity is triangular, and contains in the fœtus a viscid yellowish fluid. *Use.* Unknown.

4. *Placenta.* See Generative Organs.

2. *Lymphatic Ganglia*,

Are appendages of the lymphatic system, and appear to be all of the same structure, although in different situations they vary in *form*, in *size*, in *consistency*, and even in *colour.*

Form. Generally spheroidal. *Size.* Varying from a few lines to an inch in diameter. *Colour.* Usually pale red. *Structure.* Each ganglion consists of a peculiar tissue enclosed in a thin fibro-cellular membrane or capsule, and plentifully supplied with arteries, veins and lymphatics: but the disposition of these vessels in the ganglion, or the use of the ganglia themselves, is unknown.

PART IX.

ORGANS OF GENERATION.

These organs differ in the *sexes*, and hence a simple classification into, 1st, those found in the *Female*—and, 2d, those existing in the *Male*.

I.—FEMALE ORGANS OF GENERATION.

Arranged into *External* and *Internal* organs. The *first* comprehend the following parts, all of which can be displayed without dissection. 1st, the mons veneris—2d, the two labia majora, or labia pudendi—3d, the clitoris, with its prepuce—4th, the two labia minora, or nymphæ—5th, the orifice of the urethra—6th, the orifice of the vagina, with its accessory membrane the *hymen*, or the remains of that membrane the carunculæ myrtiformes—7th, the vestibule—8th, the fourchette—9th, the fossa navicularis.

1. *The Mons Veneris*, or eminence situated over the pubes.

2. *The Labia Majora*, or longitudinal eminences, which form the lateral boundaries of the *vulva* or external organs.

3. *The Clitoris.* A small body like the penis, situated under the mons veneris, and between the labia majora, covered by the mucous membrane, which is prolonged over it like a *prepuce.*

4. *The Labia Minora.* Triangular flaps of an erectile texture, which descend from the *preputium clitoridis*, and lie nearer the mesial line than the labia majora, by which they are protected.

5. *The Orifice of the Urethra.* A small opening leading to the bladder, which lies between the labia minora and about an inch below the clitoris.

6. *The Orifice of the Vagina.* A much larger opening than the last, which leads to the uterus, and which, in the young

subject, is frequently partially closed by a thin membrane, the *hymen ;* or when that membrane is destroyed, the shreds which are left behind receive the name of the *carunculæ myrtiformes* .

7. *The Vestibule* is that triangular space bounded above by the clitoris, below by the orifice of the urethra, and laterally by the labia minora.

8. *The Fourchette.* The inferior junction of the labia majora.

9. *The Fossa Navicularis.* A slight depression between the fourchette and entrance of the vagina.

The *second*, or internal organs, include, 1st, the Vagina—2d, the Uterus—3d, the Fallopian tubes—and, 4th, the two Ovaries.

1. *The Vagina.*

Situation. Middle of the pelvic cavity, between the rectum and bladder, stretching from the vulva to the neck of the uterus. *Form.* A cylindrical canal, bent slightly from behind forwards, and contracted a little at the two extremities. *External Surface. Internal Surface. Structure:* 1st, A *mucous membrane*, constituting the lining membrane of the canal, which presents a distinct epidermoid covering.

2. *A spongy erectile texture*, placed exterior to the mucous membrane, of a greyish colour, and thicker near the vulva than superiorly.—This tissue forms the *plexus retiformis* of some anatomists.

3. *Cellular Tissue.*

4. *The Ramifying Textures*, which are, 1st, the Vaginal Arteries—2d, the Vaginal Veins—3d, Nerves from the Hypogastric Plexus.

5. *Lymphatics.*

2. *The Uterus,*

Or lodging place of the fœtus, is a hollow pyriform or conical organ, flattened from behind forwards, and truncated inferiorly. *Situation.* In the middle of the pelvis, between the bladder and rectum, and above the vagina, with which it is continuous.

External Surface. Presenting a superior region—anterior region—posterior region—lateral regions—body—neck—os tincæ, or mouth of the womb.

Internal Surface. The *cavity* of the womb commences at the *os tincæ:*—a transverse slit, bounded by the anterior and posterior lips of the organ ; extends through the *neck*, where it is much contracted and cylindrical, and in the *body* it is wider, and takes a triangular form. This surface presents three openings, inferiorly the os tincæ ; and laterally and superiorly, the orifices of the two Fallopian tubes

Structure. 1st, Serous membrane—2d, proper uterine texture—3d, mucous membrane—4th, cellular substance—5th, the ramifying textures—6th, lymphatics.

1st, *The Serous Membrane.* This membrane covers the fundus and both surfaces of the organ, adhering firmly to the former, but more loosely to the latter. The anterior and posterior layer of this membrane unite at the lateral margins of the uterus and are prolonged to the pelvic walls, thus constituting the *broad ligaments* of the uterus, which hold important relations with the Fallopian tubes, the round ligaments, and the ovaries.

2. *The Proper Uterine Texture.* A dense elastic greyish substance, that lies immediately under the external or serous membrane. It differs from all the other textures of the body, but probably consists of muscular fibres in a partial state of development, combined with much condensed cellular membrane, and all the ramifying textures.

3. *The Mucous Membrane.* Lines the internal surface of the artery, continuous with the lining of the vagina, and above with the membrane of the Fallopian tubes. It is extremely thin, smooth, and adherent to the proper uterine texture.

4. *The Cellular Membrane.* At the lower part of the uterus, betwixt the serous membrane and proper uterine tissue, it is very loose and abundant, but in other situations it is much condensed.

5. *The Ramifying Textures.* 1st, arteries: spermatic and uterine—2d, veins—always larger than the arteries, and during gestation prodigiously increased in size, forming then the *uterine sinuses*—3d, nerves—sciatic and hypogastric.

6. *Lymphatics*, which are also enlarged during pregnancy.

Ligaments of the Uterus. 1st, *broad ligaments*, (see *serous membrane* of the uterus)—2d, *round ligaments:* two dense cords which arise from the anterior superior parts of the body of the uterus, traverse the inguinal canals, and spread upon the cellular membrane of the groins and labia pudendi.

3. *The Fallopian Tubes.*

Number. Two, one on each side. *Situation.* Upper margin of the broad ligament of the womb, within the duplicature of that ligament. *Form.* Tubular, not thicker than a crow quill, and four or five inches long; the *internal canal* almost capillary, except at the outer extremity, where it is somewhat expanded. *Internal Extremity:* Opening into the uterus. *External Extremity:* Floating in the cavity of the pelvis, and fringed; one of the fringes is usually longer than the rest, and sometimes adherent to the outer extremity of the corresponding ovary. *Structure.* External serous membrane—middle proper tunic: thick and of a spongy erectile-like texture—internal mucous membrane, which at the fimbriated extremity unites with the serous membrane of the abdomen. Cellular tissue, lymphatics, and all the ramifying textures, also enter into the structure. *Use.* To form a communication between the ovaries and uterus.

4. *The Ovaries.*

Number. Two, one on each side, about the size of pigeon's eggs. *Situation.* Posterior surface of the broad ligament of the uterus. *Form.* Ovoid, flattened from behind forwards, wrinkled upon the external surface, and sometimes presenting deep cicatrices. *Superior margin:* Attached to the superior surface of the broad ligament by a species of mesentery. *Internal extremity:* Attached by the *ligament of the ovary* to the uterus. *External extremity:* Frequently in union with one of the fringes of the corresponding Fallopian tube.

Structure. 1st, *vesicular bodies*—Graafian vesicles—varying from sixteen to twenty in each ovary, and containing a yellowish viscid fluid and the germs of the ova—2d, the nidus of these vesicles—a spongy texture, which seems to be formed by the union of condensed cellular membrane, and all the ramifying textures, peculiarly arranged—3d, serous envelope—4th, subserous membrane, dense and sending prolongations into the interior of the organ. *Use.* To secrete and lodge the rudiments of the human ova.

APPENDAGES OF THE FEMALE GENERATIVE ORGANS.

The Mammæ.

Two hemispherical eminences *situated* on the lateral and anterior part of the thorax. *External Region.* The greater part covered by smooth soft skin. About the centre of the hemisphere, a circular part of the skin becomes more delicate, and of a rosy colour: this is the *areola.* From the midst of the areola, a conoid eminence—the nipple—projects, covered with delicate skin, and pierced by the orifices of the *lactiferous ducts.*

Structure. 1st, skin—2d, subcutaneous fatty layer—3d, *mammary gland,* which consist of numerous rounded granulations, about the size of poppy seeds, and so connected by condensed cellular membrane as to constitute lobules and lobes—4th, *lactiferous ducts,* which arise by numerous radicles from the granulations or lobules: by successive re-unions, these radicles form larger ducts, which leave the central part of the gland, and terminate in twelve or fifteen conical *sinuses,* situated near the base of the nipple. From the apices of these cones small tubes arise, which traverse the middle part of the nipple, and open upon its free extremity—5th, the ramifying textures—6th, lymphatics—7th, cellular membrane. *Use.* To secrete milk for nourishing the offspring.

Milk.

This secretion of the mammary glands consists of three distinct parts—cream, curd and whey.

According to Berzelius, 100 parts of *cream* of specific gravity, 1·0244, consists of butter 4·5, caseous matter 3·5, and whey 92. Milk deprived of cream, according to the same authority, contains in every 1000 parts, water 928·75, caseous matter with a trace of butter 28, sugar of milk 35, muriate and phosphate of potassa 1·95, lactic acid, acetate of potassa and a trace of lactate of iron 6·00, and earthy phosphates 0·30.

By subtracting the *caseous* matter from the above, the remaining ingredients will indicate the chemical composition of *whey.*

II.—MALE ORGANS OF GENERATION.

Arranged into the *secreting* and assistant *excreting* organs of the semen. The *first* comprehend the testicles, and the *second* the vasa deferentia, the vesiculæ seminales, the prostate body or gland, Cowper's glands, and the penis.

THE TESTES, WITH THEIR ENVELOPING MEMBRANES.

1st, *The Testes.*

Situation.—After birth in the *scrotum:* during the greater part of the period of utero-gestation in the *abdomen. Form.* Ovoidal, flattened from side to side, presenting an *inferior margin* turned forwards; a *superior margin* turned backwards, and coasted by the *epididymis;* an *anterior extremity* directed upwards; a *posterior extremity* downwards. *Structure.* It consists of lobules that are composed principally of tubuli seminiferi, connected by fine cellular membrane, supplied by all the ramifying textures, and covered by a membrane which separates the lobules and transmits prolongations among the tubuli.

1. *The Tubuli Seminiferi.*—Extremely delicate fibres of a greyish colour, which direct themselves to the upper margin of the testicle, where they unite so as to form from twelve to twenty large tubes—*tubuli recti*—which soon unite so as to form a net work—the *rete testis*—from which proceed the vasa eferentia—which traverse the *corpus highmorianum*, and terminate in the vas deferens, or at least that part of it which commences the epididymis.

2. *Cellular Membrane.*—Peculiarly fine, as may be seen by separating the tubuli.

3. *The Ramifying Textures.*—Spermatic arteries, spermatic veins, spermatic nerves.

4. *Lymphatics.*

5. *Tunica Albuginea.*—A white fibrous membrane that invests the body of the testicle, and transmits numerous flattened prolongations amongst the tubuli. *Use of the Testicles.* To secrete the semen.

Semen.

Physical properties.—A viscid, whitish, mucous-like fluid, of greater specific gravity than water, that exhales a peculiar odour, frequently compared to that of the pollen of many plants.

Chemical properties,—According to Vaquelin, 100 parts consists of—water 90, animal mucilage 6, phosphate of lime 3, soda 1. The microscope displays also numerous animalcules with a rounded head and tapering tail moving with great rapidity in the fluid.

Use of the semen. To fecundify the ova of the female.

The Scrotum.

A pendulous bag that descends from the root of the penis perineum and inner part of the thighs, divided externally into two equal and lateral parts by a distinct line, the *raphè.*

Structure. 1st, *skin*, which usually presents numerous rugæ, and after puberty, long hairs—2d, *dartos*—a layer of loose cellular membrane, adherent to the inner surface of the skin, consequently surrounding the testicles, and also forming a partition between them. Its inner surface is in relation with part of the cremaster muscle and with a *fibrous tunic* which chiefly lines it —3d, *cremaster muscle*—See page 69—4th, *fibrous tunic:* between the dartos and tunica vaginalis, inferiorly, and between the cremaster muscle and vessels of the cord, superiorly—5th *tunica vaginalis:* a serous membrane, constituting a shut sac, which covers the body of the testicle and epididymis, and is reflected upon the inner surface of the more external fibrous membrane of the scrotum. Difference of structure at the earlier and later periods of life.

Epididymis.

Situation. Along the superior margin of the testicle. *Form.* A vermi-form process thinner in its middle part than at its extremities. *Superior extremity* or *head*, receives the *vasa eferentia*, and the inferior part or *tail* is continuous with the vas deferens, properly so called. *Structure.* The excretory duct of the testicle, coiled frequently upon itself. The links connected by cellular membrane, and in part covered by the tunica vaginalis.

Vas Deferens, and Spermatic Cord.

Vas Deferens.

That part of the excretory duct of the testicle which stretches from the *tail* of the epididymis to the prostatic portion of the urethra, into which it opens. *Relative situation.* 1st, to the spermatic cord—2d, to the bladder and vesiculæ seminales—3d, to the urethra. *Structure.* It consists of dense thick walls, of nearly a cartilaginous consistency, and an extremely small canal, probably lined by a mucous membrane; cellular membrane also enters into its composition, and all the ramifying textures. *Use.* To convey the semen from the testicle into the vesiculæ seminales and urethra.

Spermatic Cord.

A cord-like process which suspends the testicle. *Structure.* Consists of spermatic artery, spermatic vein, lymphatics, spermatic and genito-crural nerves, vas deferens, cellular membrane which connects these textures, and of two envelopes, a fibrous, and more externally a muscular.

Vesiculæ Seminales.

Number. Two—one on each side. *Situation.* Lower surface of the bladder. *Form.* Conical, flattened from below upwards; *base* rounded, and turned backwards; *apex* terminating in a narrow tube, which unites with the vas deferens, forming by this junction the *ductus ejaculatorius*, which passes through the walls of the prostate gland, and opens into the urethra. Inferior surface. Superior surface. Internal margin. External margin. Internal cavity. *Structure.* 1st, *External tunic.* Dense, similar to the vas deferens, but thinner—2d, *internal mucous membrane*—3d, cellular tissue—4th, ramifying textures. *Use.* Generally supposed to be a reservoir for the semen.

Prostate Body, or Gland.

Situation. Anterior to the neck of the bladder, between the rectum and symphysis pubis. *Form.* A truncated cone, the *base* of which embraces the neck of the bladder, aud the *apex* continuous with the membranous part of the urethra. *External surface.* Convex; *superiorly* in contact with the anterior ligament of the bladder; flattened *inferiorly*, and resting upon the rectum, *laterally* rounded, and corresponding with the levatores ani muscles. As this body is traversed by the urethra, *its internal surface* is lined by a mucous membrane, and presents also inferiorly a triangular eminence, *the caput gallinaginis*, and the two orifices of the *ejaculatory ducts*. *Structure*. Extremely dense, of a greyish colour; composed of mucous follicles, embedded in a large quantity of very condensed cellular membrane, receiving also branches of all the ramifying textures. The follicles open by small ducts into the urethra, by the sides of the caput gallinaginis. *Use*. To protect the entrance of the ejaculatory ducts, and to secrete a sebaceous fluid.

Cowper's Glands.

Two rounded bodies, each about the size of a pea, situated anterior to the prostate gland, usually between the bulb of the urethra and ejaculator seminis muscle. They open by distinct ducts into the urethra, a little anterior to the verumontanum, or caput gallinaginis.

The Penis.

Situation. Anterior part of the symphysis pubis, from which, in ordinary circumstance, it depends. *Form*. Cylindrical, elongated, and capable of erection. *Superior surface*, or *dorsum*. *Inferior surface*—*lateral margins*—*posterior extremity*, or *root*, attached to the pelvis—*anterior extremity*, or point, presenting the glans, prepuce, and orifice of the urethra. Structure—1st, skin—2d, cellular membrane—3d, muscles—4th, corpora cavernosa—5th, corpus spongiosum—6th, the ramifying textures and lymphatics.

1st, *The Skin*.—Thin, and connected by loose cellular membrane, to the deeper textures, as far as the anterior extremity of the corpora cavernosa, when it becomes free and prolonged to the point of the organ, where it forms an aperture, which varies in width in different individuals. This prolongation is the *prepuce*, a covering for the glans, and consisting externally of skin, and internally of mucous membrane, between which a layer of cellular tissue is found. A process of the mucous layer constitutes the *frenum perputii*.

2. *The Corpus Cavernosum*. A body which arises by two roots from the rami of the ischia and pubes, and extends to the glans, constituting about two-thirds of the penis; *superiorly*, grooved slightly, for the lodgement of vessels; *inferiorly*, widely and deeply grooved for the reception of the urethra; *laterally*, convex, and forming the sides of the penis; *anteriorly*, attached to the base of the glans. *Structure*. 1st, a dense fibrous membrane—2d, a cellular structure, consisting of fibrous laminæ, which cross each other, and rendered very complicated by an intermixture of the ramifying textures. *Septum pectiniforme* or *partition* of the *corpus cavernosum*:—Extending from

the pubis to the junction of the anterior with the two posterior thirds of the corpus cavernosum.

The Urethra.—The tube that conveys the urine from the bladder, as well as transmits the semen, varying from eight or nine to twelve inches. *Course.* At its commencement, it proceeds obliquely forwards and downwards, and traverses the prostate gland. It then passes through a circular opening in the sub-pubic ligament, and rises anterior to the pubis, between the roots of the corpus cavernosum. It now extends forwards upon the inferior groove of the corpus cavernosum, and anteriorly swells out into the *glans. Threefold division* of the *Urethra.* 1st, prostatic portion—2d, membranous portion—3d, spongy portion.

1st, *Prostatic Portion.* That portion of the urethra, surrounded by the prostate gland, and into which the following secretory and excretory organs pour their fluids: 1st, the testicles and vesiculæ seminales by the ductus ejaculatorii—2d, the mucous follicles of the prostate by numerous orifices—and, 3d, Cowper's glands, by two orifices.

2. *Membranous Portion.* About an inch of the canal which lies between the prostatic and spongy portions, consisting of mucous membrane, exterior to which are much loose cellular membrane, and numerous veins.

3. *Spongy Portion.* This part of the urethra commences posteriorly in a bulging, (the bulb of the urethra,) continues along the lower part of the penis, and anteriorly expands into the *glans.* This spongy tissue forms a cylindrical layer, which extends from the bulb to the glans, when it enlarges to form that last-mentioned part of the organ; but its intimate structure is not known. *Canal of the Urethra.* Varying in width at different parts of its extent; it is contracted a little, 1st, at the posterior and anterior extremities of the prostate gland—2d, along the whole membranous portion—and, 3d, at the anterior orifice of urethra. Is *wider*, 1st, at the middle of the prostate—2d, along the spongy portion—and, 3d, more particularly at the base of the glans, where it dilates, and receives the name of the *fossa navicularis.*

Mucous membrane of the urethra:—continuous internally with that of the bladder, and lining membrane of all the excretory canals: externally, at the orifice of the urethra, with the external coverings of the glans, and internal layer of the prepuce.

THE MODES IN WHICH GENERATION IS EFFECTED.

The *nature* of the generative process is involved in impenetrable obscurity. The process appears somewhat like a creation, although not to the extent generally imagined; for, at the very earliest periods of formation, a germ exists, from which all the parts that subsequently arise are developed.

No animated being *commences* to live by itself in an independent or insulated state. It is uniformly attached at first to a larger body of the same species. It constitutes for a while a part of that body; and when it has attained a certain increase of size, it is separated from the parent, and is susceptible of an independent existence.

The simplest kind of generation is the gemmiparous*, or generation by shoots. In this way the buds of trees grow into branches; and these branches again, when lopped off and transplanted, take root, and become in their turn trees.

The polypes (hydra) and sea anemones (actinea) multiply in this manner. Some worms may be made to propagate also by division; but all animals produced in this way are extremely low in the scale of existence. This mode of generation requires no distinction of sex, no copulation, nor even apparently any particular organ in which the process is accomplished.

In all other modes of generation *sexual parts* exist, but found under various modifications, both of structure and operation.

In some both sexes are united in the same individual, and such animals may be said, then, to impregnate themselves—the echinus, or sea urchin; and the acephalous mollusca, as the oyster, &c., are propagated in this way.

In some, although both sexes are found in the same individual, yet the animal cannot impregnate itself. Two individuals must co-operate, and in the act they mutually impregnate, and are impregnated. In the gastero-podous mollusca, as the snail, &c., and in some worms, the generative process is effected in this way.

In all other animals the sexes are separate, or in different individuals—the male furnishing a peculiar fluid called the semen, which must be brought in contact in some way or other with the germs or ova, which are supplied exclusively by the female, before the ova can be fecundated.

The process of fecundation is found to take place under three important modifications—1st, without corporeal contact of the sexes—2d, with the approximation merely of the external generative organs—and, 3d, with *penetration* of the sexual organs. In the first the *ova* are evacuated or *laid* before the fluid of the male is applied. In the second the fluid is made to touch the ova as they are voided by the female; and in the third the fecundating liquor is introduced into the interior of the animal, and the ova are vivified before they are discharged.

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* From gemma, a bud.

Fecundation, *without* contact, exists among the cephalopodous mollusca and some osseous fishes. In such instances the females throw off their spawn or ova, and the male seeks it out and sheds his sperm or semen over it, and fecundation results.

A somewhat closer relationship than this takes place among some reptiles, as the frog and toad, by the placing in simple juxta-position the external organs of generation. At spawning season the male fixes himself upon the back of the female; and just as the ova are being evacuated, the seminal fluid drops from the male upon them, and produces fecundation.

In the greatest number of animals, vertebrated as well as invertebrated, a still closer connection is required. The seminal fluid is introduced by appropriate organs into the interior of the female, and the ova are fecundated in the ovaria, and afterwards discharged at longer or shorter periods, and in various degrees of growth and development in different animals. Such animals are said to copulate—a process in the generative act which appertains to mammiferous animals, birds, most of the reptiles, some fishes, the hermaphrodite gastero-podous mollusca, the crustacea, and all insects.

In the greater number of animals the effect of a single copulation is confined to the fecundation of *one* generation, but the generation may include one or more beings.

In some few insects one copulative act fecundates several generations. In the aphis, or plant-louse, one act has produced eight generations; and in some monoculi it has extended to twelve or fifteen.

Even after a germ has been fecundated and detached from the ovary, it may afterwards exist in various degrees of insulation, till the new being, which is derived from it, is fitted for an independent existence. Accordingly, we find it in some animals connected by means of vessels to an organised mass, which it absorbs, and is thus nourished till the period of its birth. The germ, with its mass of nutriment and surrounding membranous, and, it may be, calcareous investments, constitutes an ovum or egg; and animals which produce their young in this manner are called oviparous. In such animals the germ is developed after the egg has been completely separated from the mother; and, for its development, heat and atmospheric air are the only agents required. In all such cases the ovum is hatched externally to the body of its mother.

In other instances, the ovum is detached from the ovarium, as in the former case, but remains within, though not attached to the body of the mother till the germ is developed and hatched. These are the false viviparous, or ovo-viviparous animals;—the viper, and some fishes, as the shark, are exemplifications.

In the last place, the germ, though primarily detached from the ovum, becomes afterwards fixed to the interior of the uterus, and derives thus its nourishment from its mother, till it is capable of enjoying independent existence. The nutriment is abstracted from the mother by an infinity of vascular roots that form the *placenta*, and from which it is conveyed into the system of the new being. All animals developed in this manner are viviparous, and include the whole of the mammalia.

In man and the higher animals, the generative process comprehends the following subordinate acts:—

1. The formation of the germ in the female ovary.
2. Copulation, or the co-operation of the male and female in fecundating the germ.
3. Conception, or the change effected upon the germ by copulation.
4. Utero-gestation, or the means employed in developing the product of conception.
5. Parturition, or process by which the product of conception is separated from the parent.

Summary of the *Laws of Development* in man and animal bodies generally:—

1. All animals originate from *germs*, in which every part or organ exists *potentially*, but *not actually*.
2. In the history of every organ of an animal body there is a formative act, as well as a process of development.
3. Every organ, during its development, undergoes a series of changes.
4. Every organ of which the human embryo is composed in the course of development displays, in a fleeting and transitory manner, the permanent condition of the corresponding organs in inferior animals.
5. All the parts of an animal body are primarily double. Some of these parts remain double, while others unite with parts of a similar nature, and thus cease to retain their duplex character.
6. The development of every part of an animal body takes place from the circumference or periphery of the part to its centre.
7. In the development of an animal body the organs and parts of which the body is composed balance each other so nicely, that an inordinate increase of the relative size of any part or organ is followed by a corresponding decrease of other parts or organs.
8. Some animal organs are occasionally arrested at early stages of their existence, while others, in the same animal, are carried to their full development: the being is then said to be malformed.

9. All malformed animals or monstrosities, as they are usually denominated, are found with parts or organs either misplaced or in a state of defective or excessive development.

10. Defective malformations depend upon an arrest of development; and the parts so formed correspond with the natural condition of the organ at an earlier period of the life of the animal.

11. Monstrosities, from excess of parts, display no new organs, but merely a repetition of those parts and organs that exist in the less complex condition, or normal state of the animal.

Lastly. All animal bodies are formed in a similar manner, whether these bodies are simple or complex, perfect or imperfect, normal or abnormal—all are formed under the influence of the same laws, and differ merely in the degree of development of organs essentially the same.

THE END.

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